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THE INTERNATIONAL COMMISSION ON GLASS— a report, with other observations of a hasty tourist

By SAMUEL R. SCHOLES

It was your reporter's good fortune to be named as the representative of the American Ceramic Society at the meeting of the International Commission on Glass in Paris, June 5 to 9, 1951. He was proxy for H. R. Lillie, President of the Society and member of the Executive Committee of the Commission. Dr. J. C. Hostetter, one of the organizers of the Commission and now an honorary Vice President, was unable to attend, and F. C. Flint and D. E. Sharp, members elected by our own Glass Division, were kept at home by business activities.

The aims and objects of the Commission have hitherto been published, but a brief review may not be out of place. They are: to stimulate cooperative effort in glass technology between different countries; to assist the international exchange of information on the art, science, and technology of glass; to arrange periodical Congresses on glass (as in 1933 and 1936); to issue reports and surveys; and assist everywhere in the development of interest in glass.

Membership in the Commission derives from several sources. Fundamentally, representative organizations, which are glass-technical societies or research institutions, support the Commission by paying fixed annual dues, apportioned somewhat as to size and ability to pay. Only one representative is admitted for each country, but a Society may represent several countries. Each representative organization, of which there are now eleven, names two members to the Commission. The president of the most recent International Congress on Glass is a member ex officio, and so is the president of each representative Society. Finally, the Commission may invite as members not more than four persons chosen from countries having no representative organization, and not more than four persons distinguished as authorities on the art, science, or technology of glass, chosen from any country or countries. Five members now come under these last two categories.

Glass Commission members pay a visit to the Institute du Verre.

The lone American delegate, accompanied by his wife, sailed on the Ile de France on May 23, arriving at Plymouth May 29. (Notwithstanding announcements that ships for Europe were fully booked, this one carried only two-thirds of its quota of passengers.) The Scholeses were met at London by R. W. Douglas, Hon. Secretary of the Society of Glass Technology, who will be remembered as a visitor at the Glass Division's meeting in Chicago in April. Through the kind offices of Mr. Douglas, effective arrangements were made for visits to his own laboratory of the British G. E. at Wembley, the Glass Department at Sheffield, and the Pilkington laboratories at St. Helen's.

In equipment, methodology, and accomplishment, these laboratories are fully abreast of similar ones in America. The staff men were generous with their time and fully displayed all that was in progress. Transportation (left-handed, of course) from and to trains was prompt and free. The visitors felt more than repaid for any similar courtesies shown to foreign visitors.

The only English factory visited was the bulb-and-tube works of G. E. Here, bulbs are blown on Westlake-Ohio machines. The company expects soon to operate a ribbon machine at another works. Tubing, large and small, is drawn by the Danner process. A remarkably thorough job was being done in cutting the tube and sorting the small pieces for diameters and weights, as a means of promoting greater efficiency in lamp-assembling operations.

Dr. B. P. Dudding of G. E., Hon. Secretary of the Commission, arranged transportation to Paris via the "Golden Arrow". This route

includes a fast train to Dover, Channel steamer to Calais, and an express to Paris. On the express, an excellent dinner was served, and customs inspection was a perfunctory routine. The French hosts had reserved rooms for some of the members at Hotel Bedford, in the Madeleine area. This hotel is worth recommending as a moderate-priced place, where English is spoken, and where Americans are made welcome and are well-treated.

Executive Committee: ***Foreground:*** **W. M. Hampton, W. E. S. Turner, and H. Vandecapelle.** ***Second row:*** **S. R. Scholes, Bernard Long, B. P. Dudding, J. M. Stevels, and R. Allolio.**

The Hotel Royal Malesherbes, nearby, was the abode of other members, and there Professor W. E. S. Turner, President and moving spirit of the Commission, held meetings of the executive committee. Present were Dr. Dudding, Vice President Bernard Long, Dr.-Ing. R. Allolio, Dr. J. M. Stevels, Mons. H. Vandecappelle, and the writer. Dr. W. M. Hampton, Hon. Treasurer, was unavoidably absent, but attended later sessions. Agenda were prepared for meetings of the full Commission, and certain decisions were reached for ratification at the final business meeting.

A proposal for an International Journal of Glass was presented by Dr. Stevels, chairman of a committee on this project appointed at the 1950 meeting.

The principal points made in favor of such a journal were: it would bring together in one publication the important contributions to the literature of glass; it would serve as the organ of the I.C.G., to publish its proceedings and papers; it would improve the present situation, where many important papers are known only in abstract —especially in America—and their significance is imperfectly gathered; the general principle of international cooperation would be definitely furthered.

This committee proposed a beginning in the form of riders or inserts in certain existing journals, to be paid for by increases in subscriptions from representative bodies. The idea of a pool of abstracts was given up, as too expensive and actually ineffective.

Serious difficulties were brought forward. The editorial cost alone would be far greater than the present income of the Commission, which is less than $1,000. Publication, to be effective, would need to be in three languages: English, French, and German. Existing periodicals now cover the field quite thoroughly. A separate committee report listed at least 340 periodicals, dealing wholly or in part with glass. The leading journals on glass might not accept the inclusion of riders.

No clean-cut decision was reached. However, the idea of riders was abandoned. It was agreed that an international journal should carry only outstanding papers, of monograph nature, and not mere reports of separate researches and, for the present, the proceedings and papers of the I.C.G. would be distributed to the members in mimeographed form.

The complex problem of standards on glass, both national and international, was dealt with in a report by Dr. Dudding. As far as our Glass Division is concerned, our direct relationship is with the A.S.T.M., and no steps have been taken to affiliate with the International Standards Organization. The question was raised, whether or not the standard glasses now assembled by the Glass Division could be made available for foreign laboratories. These matters may well become subjects for discussion and action at a future meeting of the Division, with due regard to the policies of A.S.T.M., the Bureau of Standards, and the A.S.O. About half the countries represented in the I.C.G. reported more or less affiliation with the I.S.O.

Action was taken by the executive committee to establish the official "year" of the Commission as the calendar year, January 1 to December 31. Terms of office of members named by representative bodies are to be six years, without re-election until the lapse of at least one year. Of each two members now in office, one will retire after his third year, to establish more continuity in representation.

The Nordiska Glastekniska Föreningen and the Japanese Ceramic Association were admitted to membership.

Representative bodies are urged to report dates of meetings well in advance so that conflicts preventing attendance of visitors from other countries may be avoided.

The compilation of a list of books on glass is proposed, also a compendium of definitions in glass technology. Dr. -Ing. H. Maurach has begun a list of definitions, eventually to appear in three languages. Use will be made of the A.S.T.M. glossary developed by Committee C-14.

The sub-committee on furnaces turned in an interim report on Efficiency of Glass Tank Furnaces. The work is based on the approaches made by Friedmann, Moorshead, Hampton, Crookes, and others, and it attempts to compensate for variables such as load, cullet proportion, and operating temperatures.

A number of specific subjects, on which international cooperation and agreement is held to be desirable, were discussed. These include the effects of iron in glass, annealing, viscosity, consistent symbols, methods of temperature measurement in glass tank furnaces, and the temperature intervals in which should be made measurements of certain constants, e.g., coefficients of thermal expansion, densities, and optical constants. In short, the Commission hopes for the correlation of accepted good practice, to the end that useless duplication of experiment may be avoided, and with the purpose of obtaining the most rapid developments in the knowledge of glass. Some of the above subjects have been assigned to particular groups and some await acceptance by those willing to undertake them.

It should be emphasized that the Commission does not look beyond the exchange of ideas on a scientific basis. It does not suggest that manufacturing "know-how,"

machines, or processes shall be shared across national boundaries.

The promotion of interest in glass as a material and as a subject for scientific study was given much consideration. A list is needed of all institutions of university level where teaching or research on glass is now being conducted. These are the focal points for the promotion. Other institutions need to be stimulated to undertake work on glass. By lectures, writings, and demonstrations, this interest in glass should be aroused in young people.

In May or June, 1952, the Commission will meet in London.

Two days were devoted to technical papers at meetings held in the conference room, Institut du Verre. At one of the sessions, Dr. Long was in the Chair; at another, Prof. Ribaud, Recherche de Compagnie du Gaz, and advisor to St. Gobain Co. Your reporter was chairman for a third. Papers were presented in English, French, and German. Thanks to the linguistic ability of M. Vandecappelle, who gave free translations of remarks upon request, all present managed to share in the discussions.

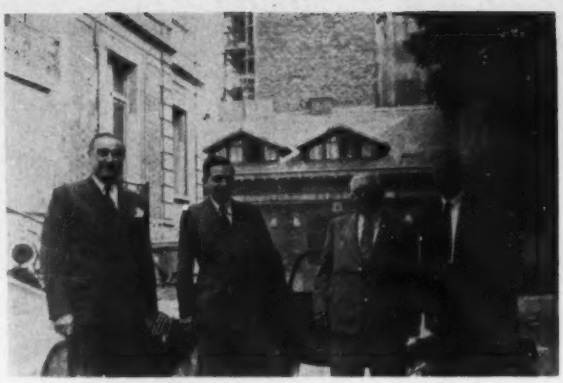
The program follows:

Symposium I

on

"Fundamental Definitions, Terms and Standards on Glass Technology"

(1) Introductory Paper by the President. (2) "The Definition of Glass and the Classification of Kinds of Glass", by Dr.-Ing. H. Maurach. (3) "The Flow-point of Glass and its Measurement", by H. R. Lillie. (4) "Easily Determined Reference Points on the Viscosity-Temperature Curve", by R. W. Douglas. (5) "Definitions and Terms associated with the Mechanical Strength of Glass", by Prof. Dr. A. Smekal. (Interval for Refreshment.) Discussion on papers 1-5. (6) "The measurement of Temperature in Glass Furnaces", by Dr. Ivan Peyches. (7) "Methods and Procedures for Determining the Temperatures in Different Parts of a Glass Furnace System", by Dipl.-Ing. L. Günther. (8) "Physical Measurements in Glass Tank Furnace Practice", by Dr. Eric Preston. Discussion on papers 6-8.



Bernard Long, L. Gunther, Adolph Smekal, and M. Thomas.

Symposium II

on

"Physical Methods for the Control of Glass Quality during Manufacture".

(1) "New Methods for the Physical Control of Glass", by Dr. Ivan Peyches. (2) "The Control of the Composition of Glass by Physical Measurements", by Dr. M. Thomas. (3) "Physical Measurements as Controls in Glass Manufacture", by J. O. Isard. (4) "The Determination of the Density of Glass by the Buoyancy of Dense Liquids", by E. Plumat. (5) "The Control of the Composition of Glass by the Measurement of Flow", by Gilard. (6) "Modern Analytical Methods in Glass Analysis", by S. C. Rademaker. (7) "The Spectrograph in a Glass Works Laboratory", by F. Hartley. (8) "The Control of the Composition of Glass by the Measurement of Electrical Conductivity", by E. Plumat. (9) "The Control and Operation of Glass Furnaces in Relation to Glass Quality", by Dr. Eric Preston. Discussion on papers 1-9.

Dr. Maurach was absent, and his paper was read by L. Günther; Scholes read Lillie's paper; Henri read the papers by Plumat; Vandecappelle gave Gilard's. The intervals for refreshment were welcome, although so much fraternizing and conversation resulted that it was difficult to get the group back on the hard chairs for more listening.

Commission President Turner and Mr. E. V. Borel of Switzerland.

Pres. Bateson and Secy. Douglas, Soc. of Glass Technology.

Dr. B. P. Dudding and Professor W. E. S. Turner.

J. M. Stevels and B. P. Dudding.

On Thursday evening, members and ladies were guests of the Glass Manufacturers' Association of France at a dinner in the Eiffel Tower. About sixty persons were served in the most magnificent French manner. After a speech of welcome by President Arbeit of the Association and a response by Professor Turner, the company stepped out to the balcony and all room lights were extinguished. Paris, with its chief buildings flood-lighted in celebration of the 2000th year of the city, offered a beautiful sight from the 250-foot elevation.

Mons. A. Mathieu and Dr. Ivan Peyches, as hosts to the Commission, prepared a tour for Friday. Buses took the entire group to the new laboratories of St. Gobain, now partly complete. The building, the only example of new construction apparent in the whole city of Paris, has been designed to include in the central portion ample space for pilot plants. Even the electrical melting of refractories can be carried out. Mezzanines with more electrical equipment surround the large, high central space, and along the outer walls are numerous individual laboratories for all sorts of experimental work. Dr. Peyches, head of the laboratories, acted as guide.

The next port of call was the optical glass plant of Para-Mantois. The furnaces here, fired by producer gas, contain individual covered pots, each with a crown opening over which a lid may be drawn. No casting is done. Although the methods of selection, cobbing, and forming of blanks seem fairly laborious and antiquated, the quality of the product is undoubtedly high. Light refreshments were served at M. Mathieu's home, near the plant.

An excellent luncheon was served in St. Germain, where the president of the chamber of commerce of Versailles acted as host. The party was then taken to the Palace of Versailles to be guided through the scenes of the past glories of the Bourbon regime.

The final business meeting of the Commission took place on Saturday morning. The actions of the executive committee were ratified. A vote of thanks was given to Messrs. Mathieu and Peyches for their hospitality and care in arranging affairs.

As a closing event, the members were entertained at an elaborate luncheon at the Pre Catalan Restaurant in the Bois de Bougogne. The host was Baron Hely d'Oissel, President and Director-General of St. Gobain company, and he was assisted by M. Grand-George, his second in command. Toasts and felicitations furnished appropriate ceremonies. The irrepressible Eric Preston added some feats of legerdemain.

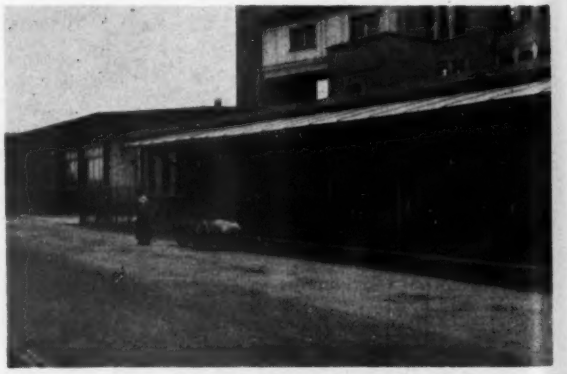
The membership of the Commission is listed as follows:

Members Appointed from Societies and Institutes: American Ceramic Society, Mr. Francis C. Flint*, Mr. Donald E. Sharp*; Czechoslovak Ceramic and Glass Society, Professor Dr. -Ing. M. Fanderlik*, Dr. -Ing. J. Stanek*; Deutsche Glastechnische Gesellschaft, Dr. -Ing R. Allolio, Professor Dr. A. G. Smekal; Society of Glass Technology, Emeritus Professor W. E. S. Turner*, Dr. W. M. Hampton*; Union Scientifique Continentale du Verre, Mons. G. Henri, Dr. J. M. Stevels; Glasinstitutet Stiftelsen i Växjö, Sweden, Herr Y. W. Anderberg*, Herr B. Simmingsköld; Glass and Ceramic Research Institute, Calcutta, India, Dr. Atma Ram*; Institute Nationale du Verre, Belgium, Professor P. Gilard*, Mons. H. Vandecappelle; Institut du Verre, France, Mons. A. Mathieu, Dr. Ivan Peyches. *Member Ex Officio:* President of the International Congress on Glass, Dr. B. P. Dudding.

Presidents of Societies: American Ceramic Society, Mr. Howard R. Lillie (S. R. Scholes); Czechoslovak Glass and Ceramic Society, Dr. -Ing. M. Lewinter*; Deutsche Glastechnische Gesellschaft, General Direktor N. von Bülow; Society of Glass Technology, Mr. Herbert A. Bateson; Union Scientifique Continentale du Verre, Dr. Bernard Long. *Members Appointed Directly by the Commission:* (i) Professor Dr. -Ing. J. A. de Artigas (Spain), Mons. E. V. Borel (Switzerland); (ii) Professor A. H. M. Andreasen (Denmark)*, Herr E. Hald (Sweden).

Other technologists in attendance included R. W. Douglas, representing Pres. Bateson of the Society of Glass Technology; Messrs. H. Cole and F. Hartley, of Pilkington Bros.; J. O. Isard and E. Preston, of British G. E.; L. Guenther, Ass't. Secy., D. G. G.; M. Thomas, of Osram Co., Germany; S. C. Rademaker, Holland; H. Bateson, S. Africa; E. P. Gooding and Edw. Meigh, England; and Andrè Deschamps, of the Belgian LOF.

Mr. E. V. Borel, the Swiss electrical engineer who has done more than any other one man for the development of electrical glass melting, invited your reporter and his wife to visit some of his installations. Accordingly, they went to Lausanne, finding an excellent room in a hotel overlooking Lac Lèman and offering a view of snowy mountains across the lake. For two wonderful days, Mr. and Mrs. Borel, with the help of his factory manager Mr. Grossenbach, took the tourists on rides to factories, on drives through the mountain valleys, and finally up on a funicular to the 6000-foot elevation of Rochès de Naye. On this summit, the snow still remained. The views of the Rhone valley and of the higher snow-covered peaks to the south and west cannot be forgotten. Nor can the visitors ever forget the cordial hospitality of the Borels.



Bicycle shed and dog cart at Romont.

* Absent.

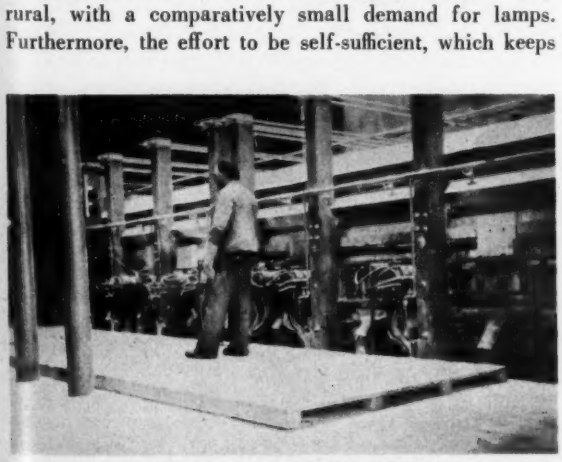
Left: The Borels at Roches de Naye. Right: Gatherers of Alpine flowers.

With hydro-electric power available at a cost around one-half cent per kilowatt-hour and while the country has no native fuel except wood, electrical melting is essential for the glasshouses of Switzerland. Energy consumption runs about one kw.-hr. per kg. of glass, or 900 kw.-hr. per (American) ton. This means a direct melting cost of $4.50 per ton—not extravagant, even by our standards.

In the Borel system, several pairs of hard carbon electrodes run horizontally across the tank, meeting in the center. Three-phase current flows from the sides of the electrodes, which are submerged about one foot in the glass. Alternate pairs of electrodes complete the circuits so that the currents have relatively long paths. The carbons are porous and hollow, and much of the gas generated by slow oxidation escapes to the outer ends. Bubbles of monoxide rise to the surface of the melt and burst into flame. Current paths are broad, and current densities are found to be correspondingly low. The surface of the melt is not particularly hot, but in the current zone beneath, the temperature must be much higher.

At Electroverre Romont, such a furnace supplies two Fourcault machines. The width of sheet and rate of drawing are comparatively small. Thicknesses between 0.024-inch and 0.280-inch are drawn. Glass color and quality are excellent.

The Dukes plant at Fribourg has an electrical day tank, at which a dozen shops blow lamp bulbs of all sizes by hand operation. The economy of such operations is difficult to understand, unless we remember that Switzerland has fewer than 5,000,000 population, largely rural, with a comparatively small demand for lamps. Furthermore, the effort to be self-sufficient, which keeps Swiss money the soundest in Europe, precludes expending capital to import heavy machinery.



Tank at Electroverre Romont.

Near Lausanne is a bottle plant, in which a continuous tank is partly oil-fired and partly electrically heated. Lynch machines are used. The bottles were not packed in cartons, but were stacked in the yard, to be hauled away in bulk. A feature of a Swiss factory is the bicycle shed, using much less real estate than the corresponding American parking lot.

The Journey from Paris to Geneva had been made by air. Swissair has never had an accident: a record achieved by making sure of weather. This involved waiting two hours at Le Bourget for a light drizzle to clear. However, slipping a plane through a narrow pass and down to the Lac Lèman level does require good visibility. The sight of Mont Blanc is some compensation for the bumpy ride over the border mountains. Return from Lausanne was by "wagon-lits". The main departures from the Pullman system of "roomette" cars are that tickets are sold by Cook's, not by the railroad; that no compartments are assigned—one scrambles; and that the toilets at the ends of the cars are without distinctive labels.

Dr. Eric Preston and the writer were invited to visit one of the St. Gobain plants, at Orleans. Mons. P. L. Bertrand, Technical Director, sent us in convoy of one of his young men, who spoke English and furnished transportation. The distinguishing feature of the Orleans plant is the "booster" or "cell" system of applying the electrical heating. After the glass has been melted from batch and partly cleared under oil fire, it flows into a cell in which electrodes rising through the bottom apply current to produce, rather quickly, an exceedingly high temperature. From the cell, the glass flows through a narrow channel to H-E feeder forehearths. One furnace has two such cells, leading to right- and left-hand channels. Coloring materials are added in the cells, enabling the operators to produce two different colors of glass at the feeders. Some small pressed dishes were being made, tempered by air-blowing as they came from the polishing fires.

Orleans suffered somewhat during the recent War. The stonearch bridge over the Loire river lost two spans, one blown by the Allies, one by the Germans. Skilful repair work has restored the bridge to its ancient appearance.

And so to the "Mauretania" and a quiet crossing home. One returns from such a trip with the feeling of having made many new friends, whose technological progress he admires, and whose many kindnesses have helped immeasurably to make the visit an enjoyable and profitable one.

EAST ASIATIC GLASS

By DOROTHY BLAIR

PART II—KOREA

That glass was known quite early in Korea is an established fact because of glass artifacts found in early tombs. Some of these finds are clearly of foreign type, probably imported from western Asia, but others point to a native origin.

Tradition attributes the founding of Korea to the year 2333 B.C., the first chronological period extending to the year 1122 B.C. In 1122 a political refugee from China, nephew of the last king of the Chinese Shang Dynasty (1766-1122 B.C.), together with many followers, is said to have fled to Korea where he set up a kingdom, with his capital in the vicinity of the modern Pyongyang. He is alleged to have introduced a number of the arts, which, one would suppose, were probably Chinese in nature. His descendants ruled until the second century B.C.

From 108 B.C. until 313 A.D. northern Korea was controlled by the vast Chinese Han Empire (206 B.C.-221 A.D.). It was divided into the "Four *Guns* (or districts) of Han," of which the best known to us is Lo-lang (Korean: Naknang; Japanese: Rakuro), whose cultural center in the vicinity of the present Pyongyang (Japanese: Heijo) became famous through the splendid scientific explorations and reports of Japanese archaeologists. At the time the Soviet Union took over Pyongyang as their headquarters in the occupation of North Korea in 1945, the Museum there was a great treasure-house, for it was Japanese policy not to remove excavated finds from the country. Instead, they erected a number of fine modern museums in the neighborhood of excavated sites to house and preserve the treasures of Korea's past. The fate of these museums and their contents today is a matter of grave concern.

Fig. 1. Chinese Glass Bead of the "capstan" type. ***Courtesy of The Toledo Museum of Art.***

The vastness of the cemeteries of Lo-lang and the richness of the accessories buried there with the deceased Chinese provincial officials and their families are mute evidence of the importance of this Han outpost. Mention has already been made of the so-called "capstan" or "drum" shaped ear ornaments (Fig. 1) of transparent blue glass found in China, in Central Asia, in Indo-China, in South Manchuria, and here in Korea.[1,2] The common use of this same ear ornament over such a wide range in China itself and in her colonies under the Han Empire immediately suggests a Chinese origin for them all. Furthermore, here in Lo-lang some of the lacquer utensils excavated from the tombs bear inscriptions giving the date, names of artisans, and the place of manufacture in China. If lacquer was brought from the homeland, very likely glass would be also. I do not know of any clear evidence of local manufacture of glass at Lo-Lang,[3] nor of any such ornaments found anywhere in Korea south of the Chinese colonies, nor in Japan.

The Lo-lang finds are particularly important because the tombs were skilfully investigated and the excavations completely reported. Even the *use* of the "capstan" beads became evident through these excavations. In several coffins the ornaments were found just where ear ornaments would lie in relation to the body buried there. In one instance, two small semi-spheric glass pieces, each pierced with two holes, seemed to have been suspended from the ear ornament by a thread inserted through the bore. In more than one burial small glass rings, which may have served as rims, were found associated with the ear ornaments. Simple small blue beads were also found at Lo-lang, and also some lacquered objects with glass inlays.

Glass found in ancient sites of southern Korea is, however, of much more interest and significance than these comparatively minor finds at Lo-lang. Contemporary with the Chinese dominion in the north, two kingdoms were developing in the south: Pakche in the southwest and Silla in the northwest. Later, these, together with the Kokuryo kingdom which replaced the Chinese Han colonies in the north, formed the "Three Kingdoms" of the early centuries of our Christian era. The three were finally merged in 668 A.D. when the Silla kingdom conquered the other two and the first unification of the Korean peninsula came about.

Kyongju (Japanese: Keishu), the capital of Silla (Japanese: Shiragi), is as romantic a spot as one could desire.[4] Here are impressive remains of a powerful, wealthy, and artistic people, skilled in architecture, sculpture, in bronze casting and other arts, and with connections with China, Central Asian districts, perhaps with India, and even, though indirectly, with the Hellenistic, or "Roman," culture of western Asia. At the same time they showed a distinct and highly creative individuality of their own. Ancient royal tumuli, some of great size, still rise unexcavated on the outskirts of the present village. From other tumuli already excavated came amazing objects which had long lain interred with the re-

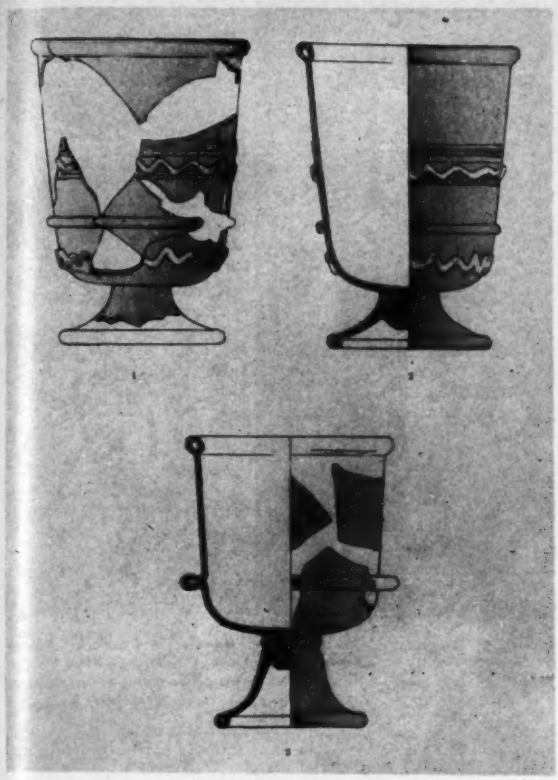


Fig. 2. Reconstruction of Fragments of Two Goblets, found in the Gold Crown Tomb at Kyongju. From Hamada and Umehara (see Bibliography), Pl. XXXII.

Fig. 3. Detail from a painting on silk found at Tun-huang, West China. Thought to be late T'ang Dynasty (618-906 A.D.). (cf. Sir Aurel Stein, Serindia, Pl. LXXIX). *Courtesy of the British Museum, London.*

mains of the royal rulers of Silla. Gold, mined in quantity in Silla, is prevalent. Glass was found in some quantity and in considerable variety of workmanship and color. Some glass examples seem, without much question, to be importations; others suggest possible native imitations of foreign models; still others bear unmistakable native characteristics.

From the Gold Crown Tomb at Kyongju, the first to be excavated (in 1921), came the two glass goblets illustrated in Figure 2. Though both are broken, their original form could easily be determined. They are of clear blown glass, transparent and somewhat greenish-blue. One has two zigzag lines of applied blue glass thread; the other, one simple raised ridge around the lower body. Their foreign source is not questioned. Silla had at times very close connections with the Chinese court, and likewise often had within her borders people from Central Asia and beyond. But whether these goblets came as a gift from China to the King of Silla, or whether they came directly from a more distant land, we do not know. That they were rare and highly treasured is obvious.

From the Gold Phoenix Tomb there was recovered intact a bowl of dark blue translucent and bubbled glass, the metal quite similar to much of the evidently native glass. This is less convincingly foreign although it resembles one of the goblets in that it has the single ridge about the body. One is drawn by the idea that it may be Korean work, inspired by the foreign.

Two bowls, also intact, from the Gold Belt Tomb are of greenish, bubbled glass, with two rows of applied blue knobs. One is reminded of bowls of apparently similar glass represented in paintings found at Tun-huang on the westernmost border of China, the terminus of the caravan route across the desert (Fig. 3).

Glass beads (Figs. 4-5) are so numerous in Korean tombs of this era that their very quantity and prevalence must signify local production. Often they are rather crudely made, which again suggests local manufacture, since they would scarcely seem to warrant quantity transportation from a distant source. They were used in necklaces, bracelets, and crowns and perhaps in other ways. A favorite form of necklace was made up of two or more strands of small beads with a large thick claw-shaped *magatama* bead (see below) suspended in the lower center, holding the strands together at that point. Similar, but smaller, groupings formed bracelets.

These Korean beads vary in color and size. A rich dark blue glass is the most prevalent. Other colors are green, yellow, brown, pale blue, medium blue, turquoise blue, opaque white, and occasionally red. Some are translucent or transparent, some opaque; some are clear, some thickly bubbled; some are even patterned in color. In contrast to the Chinese beads of the Chou Dynasty, they are light in weight. Little chemical study has been devoted to these beads but they would seem to lack lead and barium, although both elements are deposited somewhat freely in Korea. Messrs. Seligman and Beck examined a few Korean beads and found them "essentially sodium-calcium silicates, with small amounts of coloring oxides".

One recurring bead form worth noting is of simple structure but very interesting in effect. A thread of glass was spiraled around a core, sometimes in half a dozen or

Fig. 4. Glass Beads of Various Types, 4-7th Centuries A.D. *Courtesy of the Owner, Mr. Fujio Koyama, through the National Museum, Tokyo.*

Fig. 5. Glass Beads of Various Types, 4-7th Centuries A.D. *Courtesy of the Owner, Mr. Fujio Koyama, through the National Museum, Tokyo.*

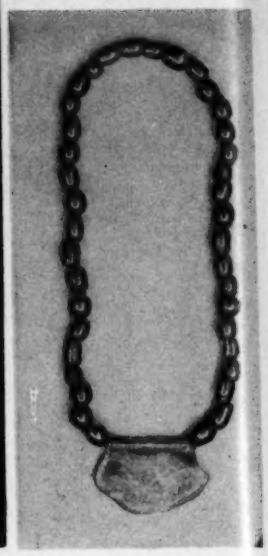


Fig. 6. Necklace of translucent bright blue glass. *Courtesy of The Cleveland Museum of Art.*

more turns. Examples of this type are included, among others, in Figure 4.

A necklace in The Cleveland Museum of Art (Fig. 6) is, in my experience, unique. The chain, made up of translucent bright blue beads, supports a roughly shaped, flat pendant of the same color with the bore running horizontally along the upper edge. The glass is light in weight, with many bubbles. The pendant is uneven in outline and its surface is wavy and uneven, and the metal is rather cloudy in spots. Surely this is native work, and experimental.

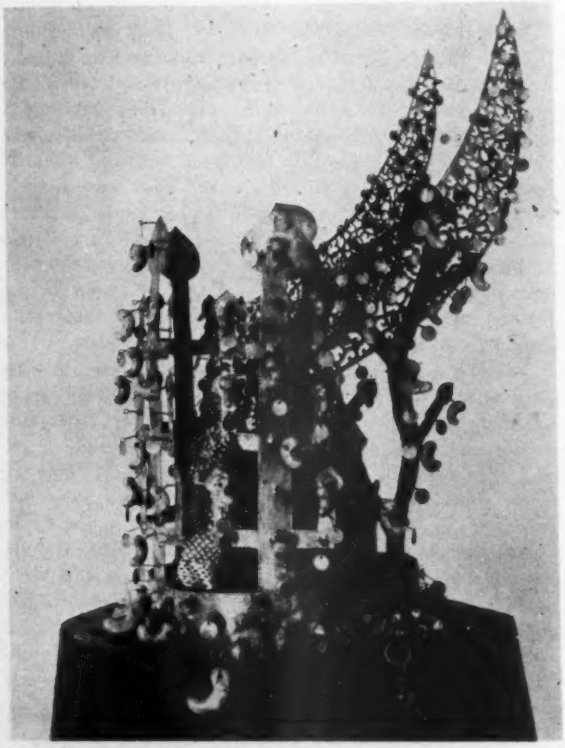


Fig. 7. Gold Crown with attached *magatama*. From the Gold Crown Tomb at Kyongju.

During a 1946 excavation in Kyongju by the Koreans a lacquered mask for some religious occasion was brought forth which has inlaid eyes of blue and white glass set in circular rims of solid gold.[5]

An ancient decorative form found only in South Korea, Japan, and the Ryukyu Islands is a curved object reminiscent of an animal claw, which the Japanese call *magatama*, or "curved jewel". Though the great majority are carved from stone, some are of glass and provide indisputable proof that glass was produced locally because there would have been no importation at that time from China or farther west of an ornament of such peculiarly local significance.

Magatama show variety in size and quality. Used as beads and as pendant ornaments (having always a perforation in the "head"), they originally carried far more significance than mere decoration and served in some talismanic role. In Korea they have been found singly or as an important part of necklaces. The golden crowns of the kings of Silla have many *magatama* attached to them by wires (Fig. 7). These are mostly of jade or other stones but in some crowns glass is also used.

The ceremonial costume of these kings of Silla, as found in the burials, included ornamental girdles of decorative golden plaques hinged together to form a belt from which numerous other series of plaques or chains

(*Continued on page* 428)

RECENT TRANSLATIONS OF RUSSIAN PAPERS OF INTEREST TO THE GLASS INDUSTRY

Abstracts of two papers which appeared in the Russian journal of the glass and ceramic industries.

MEASUREMENTS ON A WORKING GLASS FURNACE

A. A. Sokolov, in *Steklo i Keramika* (Glass and Ceramics) 7, No. 12, p. 11-19 (1950), published results of his measurements on a working glass furnace used to make (apparently) Fourcault glass. The main results are given in graphs.

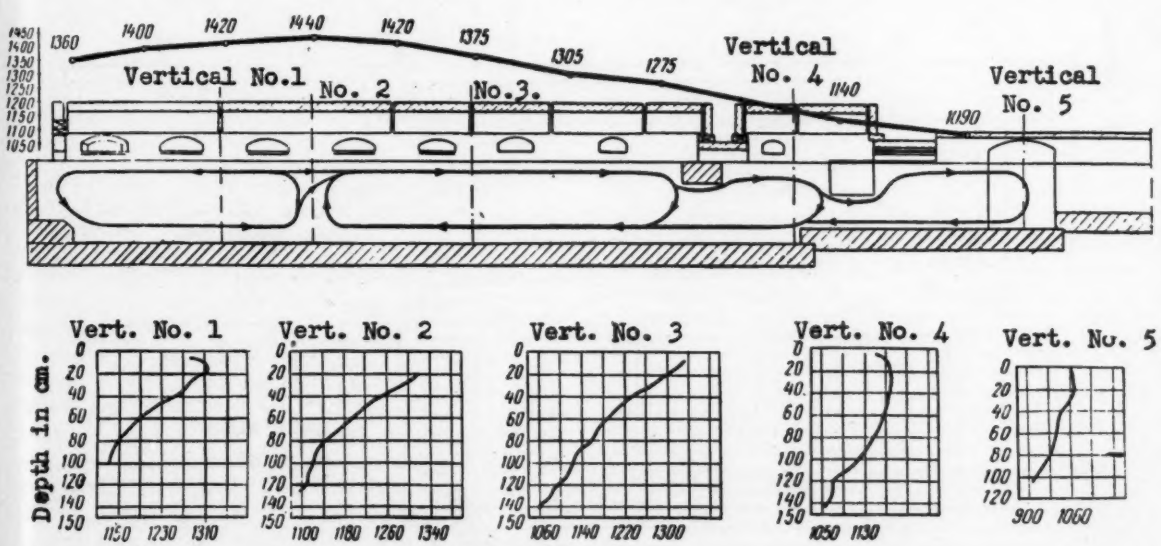
Graph I consists of two parts. The upper part represents a longitudinal section (elevation) of the furnace and, superimposed on it, the temperatures of the wall between some of the burners. These temperatures have been measured with optical pyrometers. The scale of the temperatures (in degrees centigrade) is shown on the left and the temperatures are marked also at the curve. The highest temperature of the wall was thus observed between the third and the fourth burners where it reached 1440°C. The wall in the working part of the furnace (extreme right of the graph) had the temperature of only 1090°C.

The upper part of Graph I shows also the direction of convection currents in the melt, determined on a model in which colored glycerol was playing the part of glass.

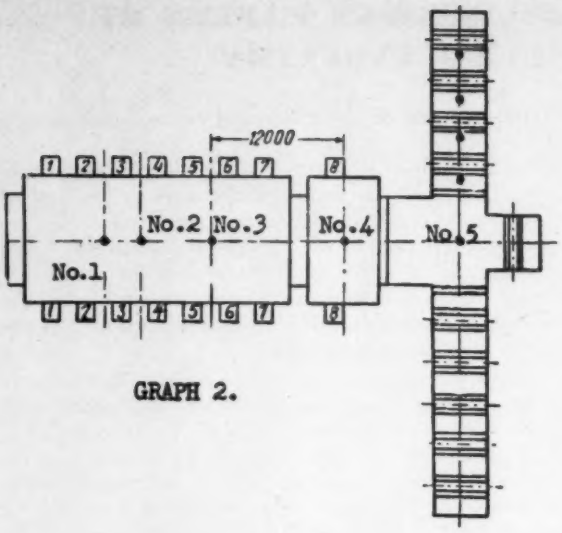
The five vertical broken lines show the positions along which the temperature was measured at different depths of the glass melt. Graph 2, a plan of the furnace, shows again these positions. The figure 12000 in this graph is the distance between the third and the fourth verticals in millimeters. The bottom part of Graph I presents the results of the measurements (whose procedure is not described). The depth of immersion (in cm.) is plotted along the ordinate, and the temperature (in °C.) along the abscissa. It is seen that the surface temperature between the second and third burners, under the batch, is 1270°C., reaches 1310°C. 20 cm. below the surface, and then gradually decreases with increasing depth. Along the second and the third verticals the temperature is lower the lower the level, and the average gradient of temperature is 2.2 and 2.0 degree/cm., respectively. In the unheated part of the furnace (verticals No. 4 and No. 5), the surface is again cooler than the sub-surface layer. In the middle of the working channel (No. 5) the highest temperature (1070°C.) is observed about 20 cm. below the surface of the glass.

Graph 3 represents the variations of temperature in time when the furnace supposedly was in a steady state. Four thermocouples were fixed along the vertical No. 5. The upper was 100 mm. below the glass level, and the following were at the depths of 200, 300, and 400 mm., respectively. The observations lasted for 4 hours, and the abscissa of the graph shows hours and minutes. The temperatures in °C. are plotted along the ordinate. It is seen that at the depth of 200 mm. the temperature remained almost constant between 1055° and 1060°C., but the higher layers gradually became hotter and the lower layers cooler. Apparently, before the alleged steady state was reached, the furnace was cooler, and the cooler glass mass, after reaching the end of the furnace, was returning along its bottom. The greatest temperature difference observed at a point during the four-hour run was as great as 39°C.

The movement of heat in the gas space of the furnace was determined using special thermocouples. Each of these consisted essentially of a steel cylinder to whose bases two constantan wires were welded. Cold water flowed through one half of the cylinder, and from the temperature differences between the two bases the dimension of the heat flow could be calculated. Above the batch and before the first pair of burners the heat flow toward the glass was 92000 cal./sq. meter x hour. Above the glass melt it was 54000 between the second and third



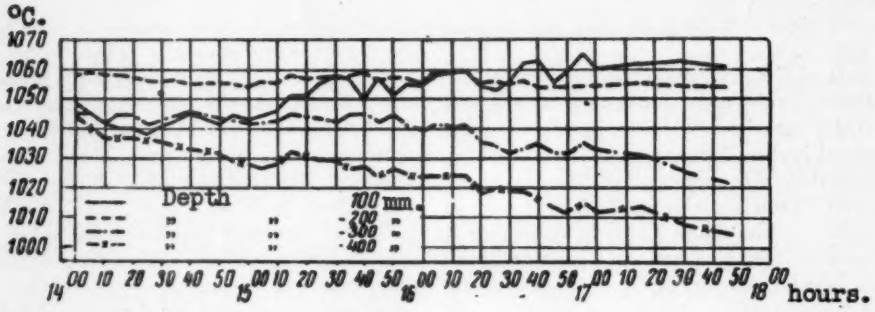
GRAPH 1.



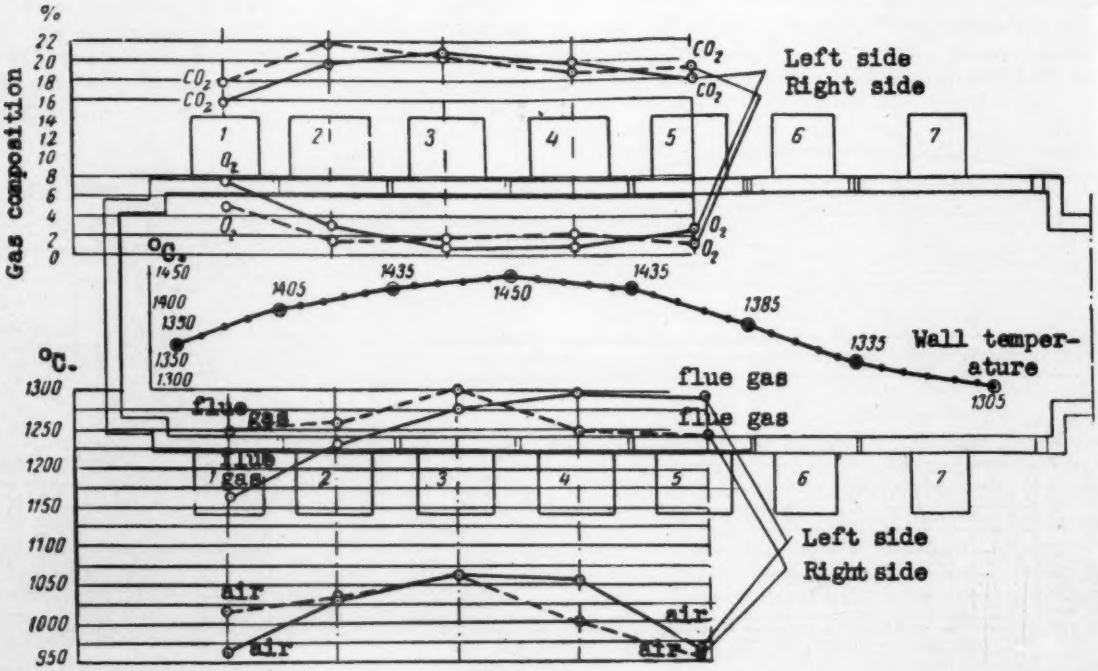
GRAPH 2.

pairs of burners, 42000 between the third and the fourth pair, 41200 between the fifth and the sixth pairs, and 24000 between the sixth and seventh pairs. It was 4500 above the refractory boat and 16000 above the glass melt in the unheated part, in both instances directed downward, but 5200 from the glass to the roof in the working channel. The horizontal heat flow from the hottest zone to the loading zone was 88500 and to the unheated part, 30600. Two interesting facts emerge from these figures. One is that the heat consumption by the batch (92000) is nearly twice as great as the heat consumption (54000) by the nearby glass melt. The other is that in the working channel (near No. 5 of Graph 2) the glass surface loses heat, although the roof is hotter than this surface. This peculiarity is due to the circulation of gases above the melt. Hot gases move under the roof toward the working end of the furnace, cool there, and the cooler gases (of about 1100°C.) move toward the loading end above the glass surface.

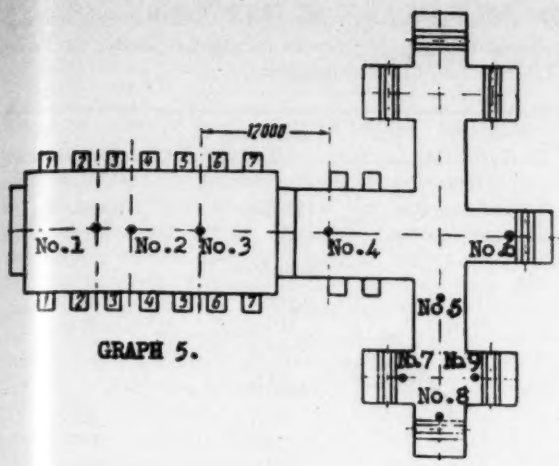
Refractory "swimmers" were placed on the glass melt surface, and the direction and rate of their movement



GRAPH 3.



GRAPH 4.



GRAPH 5.

was determined. The results are given in units which are not specified in the original paper.

Graph 4 summarizes the temperatures and the gas compositions in the first 5 burners. It is seen that the temperature of flue gases in the vertical shaft of the first left-hand side burner was only 1160°, by 90°C. less than the corresponding place of the first right-hand side burner. The air temperature in the third pair of burners was identical right and left. These temperatures were determined by thermocouples inserted in the shafts and differed from the temperature of the shaft walls determined with an optical pyrometer. The flue gases of the first pair of burners contained 16-18% CO_2 and 5-8% O_2, and of the 5th pair 18-20% CO_2 and 1-3% O_2, although a reducing atmosphere near the first, and an oxidizing atmosphere near the fifth pair would have been more advantageous.

Table I represents the heat account of the furnace, both in calories/sec. and in percents.

TABLE I

Heat Profit			Heat Loss		
		A. Heated part			
	cal./sec.	%		cal./sec.	%
Heat of combustion of the producer gas	2710	60.4	On glass making	718	16
Physical heat of the gas	776	17.3	Escape with flue gas	2640	58.7
Physical heat of the air	1009	22.3	Radiation toward the unheated part	150	3.3
			Radiation through loading window etc.	133	3.1
			Flame escape through the opening for pyrometer	93	2.0
			Through roof	5	0.4
			In convection streams	480	10.0
			Others	276	6.5
	4495	100.0		4495	100.0
		B. Unheated part			
	cal./sec.	%		cal./sec.	%
Radiation from the heated part	150	14.3	Radiation toward the cool end	17	1.7
Convection stream	480	45.7	Convection stream	236	22.8
Production stream	417	40.0	Production stream	377	36.0
			Others	417	39.5
	1047	100.0		1047	100.0

An analogous study has been carried out also for a furnace of a less conventional type shown in Graph 5.

EFFECT OF ANNEALING ON MECHANICAL AND CHEMICAL PROPERTIES OF WINDOW GLASS

In connection with the projected revision of the Russian standards for window glass, N. A. Tyuremnova and S. G. Lioznyanskaya in *Steklo i Keramika* (Glass and Ceramics) 7, No. 11, p. 3-7(1950), published a study on the relation between the degree of annealing and other properties of glass.

The sheet glass tested apparently was produced in Fourcault machines. It was obtained from 3 different glass plants (A, B, and C), and its composition was:

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	SO_3
A	71.40	0.54	0.17	8.53	3.01	15.83	0.52
B	71.16	0.21	0.09	8.65	3.08	15.73	1.05
C	72.55	1.54		7.66	2.74	15.49	—

The present standard sets down 20 mμ/cm as the greatest permissible birefringence of regular sheets (thickness 1.9-2.4 mm.) and 25 mμ/cm as the greatest permissible birefringence of double sheets (thickness 2.7-3.3 mm.). Of the samples tested from plant A, 76% of the regulars but only 44% of the doubles complied with the standard. Of the B samples, only 10% and 18% were up to the standard for the regulars and the doubles, respectively. Only doubles of plant C were tested, and only 29% of these had a permissible birefringence. The rate of withdrawal was 60 meters/hour for the regular and 40-45 meters/hour for the double sheets.

The authors believe that not only the glass works are to blame for this discrepancy. The standards, they argue, are too rigid and do not pay sufficient attention

to the effect of sheet thickness. As far as the degree of annealing is concerned, there are three main groups of specimens. Group I includes sheets whose birefringence is 6.1-8.0 mμ/cm. *for one millimeter of sheet thickness;* group II has birefringence between 8.1 and 10.0 mμ/cm. for one mm.; and group III between 10.1 and 12.0 mμ/cm. for one mm.

The mechanical and chemical behavior of specimens of these 3 groups was then compared.

To measure the breaking stress in bending, specimens of 100x200 mm. with untreated edges were placed on two parallel metal rollers, the distance between whose axes was 185 mm., and then broken by loads applied to a third roller. Table I shows that the breaking stress is smaller when the birefringence is greater. This seems to contradict the rule derived from the behavior of toughened glass, but presumably is explained by non-uniform distribution of residual stresses along the cross-section of the sheet.

TABLE I

	Mean birefringence mμ/cm. for mm.	Mean breaking stress kg./sq. mm.	Standard error
		Regulars	
Group I	7.1	5.36	3.3
Group II	8.7	5.00	3.1
Group III	10.5	4.88	5.4
		Doubles	
Group I	7.6	4.07	4.7
Group II	9.0	3.90	3.8
Group III	11.1	3.59	6.8

The impact resistance was measured by dropping a ball of 66.44 g. on 100x100 mm. specimens fixed in wooden frames with rubber protection. Table II shows that the degree of annealing has no definite effect on the impact resistance. Perhaps an effect would be discernable if the spread of the values were smaller, see the great standard error. Double sheets are weaker than the regulars, presumably because also, in this test mainly, the bending stress was operative.

TABLE II

Mean birefringence mμ/cm. for mm.	Mean impact resistance kg. cm./cu. cm.	Standard error
	Regulars	
7.2	2.77	11
8.7	3.20	6.6
10.8	2.09	6.8
	Doubles	
7.5	1.50	8.8
9.2	1.30	6.3
10.8	1.50	10.4

For measuring thermal endurance, specimens of 30x100 mm. were heated to a definite temperature and then immersed into water of O°C. The lowest heating temperature causing cracks in glass is shown in Table III, based on 125 measurements.

TABLE III

Mean birefringence mμ/cm. for mm.	Heating temp. °C	Standard error
	Regulars	
7.1	106.3	1.3
9.0	101.3	1.2
10.7	98.7	1.2
	Doubles	
7.4	99.7	2.0
9.2	94.8	0.9
11.1	93.6	0.97

The temperature decreases when the residual stresses increase. Earlier observations on sheets annealed in laboratory furnaces showed the opposite behavior. Presumably, production specimens used in the present work were less uniform than the laboratory samples.

The chemical stability of the glass surface was determined as the loss of weight of glass immersed in *N* sodium hydroxide solution according to the (Russian) standard procedure. There was a difference between the stabilities of the three glasses A, B, and C, and the corresponding data are shown separately in Table IV.

TABLE IV

Mean birefringence mμ/cm. for mm.	Mean loss of weight mg./sq. dm.	Standard error
	Glass works A	
7.4	35.7	3.6
8.9	38.2	3.8
10.7	41.5	3.5
	Glass works B	
9.3	42.6	4.5
10.9	43.8	2.4
12.7	43.3	2.0
	Glass works C	
7.1	37.8	2.5
9.0	43.5	2.6
10.8	42.5	4.0

It is seen that the stability is greater the smaller the residual stresses.

Thus, all the measured properties of glass improve when the degree of birefringence decreases. The authors propose 9 mμ/cm. for 1 mm. as the common standard for window glass of whatever thickness.

• Jack Solomon, of Seaboard Corporation, has accepted the Chairmanship of the Glass Division of the Greater New York Committee for State of Israel Bonds, and will lead an intensive campaign for the sale of Israel's half-billion dollar Independence Bond Issue.

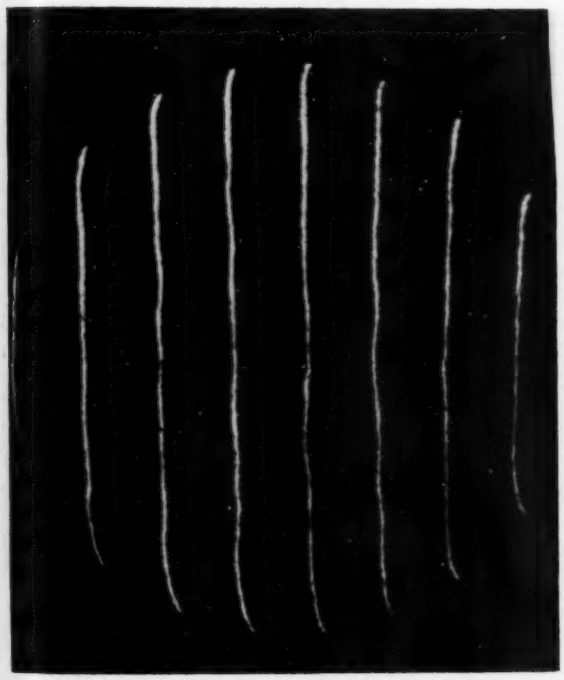
CONTOUR MAPPING OF OPTICAL SURFACES WITH LIGHT WAVES

Contour maps of precise optical surfaces, whose contour intervals are a small fraction of a wavelength of light, have been prepared by James B. Saunders in the Optical Instruments Laboratory of the National Bureau of Standards. By contrast, the usual contour map of a topographic surface may have contour intervals of several feet or more. The optical maps serve the same purpose as topographic maps, except that they reveal ridges and depressions measured in millionths of an inch rather than in feet or inches. For example, optical flats, which are quartz plates for calibrating the precision gages used by science and industry, must be flat within one five-millionth of an inch. Their surfaces must also be parallel to the same tolerance. The new maps can be used for checking the accuracy of these surfaces.

The maps are made by photographing the interference patterns that are formed when light waves are reflected from the surfaces of the specimen and a standard reference of known shape. In itself this is simple interferometry and is common practice in precision measurements of glass optical surfaces. The basic procedure, however, has been modified appreciably in the preparation of the new maps.

The customary procedure is to place the surface that is being analyzed close to and almost parallel with the standard surface, leaving a thin layer of air between. The lines or fringes produced by the interference of monochromatic light reflected normally from these two surfaces then give a good indication of the quality of the surface. When proper adjustments have been made, the fringes are one-half wavelength apart. Ordinarily these fringes are relatively broad and appear dark against a bright background. Gross irregularities in the surface will cause these lines to bend, and their appearance is a fairly good measure of how smooth the surface is. However, irregularities of several tenths of a wavelength can go undetected if they fall within the area between two adjacent lines. Even smaller irregularities (up to several hundredths of a wavelength) can be completely hidden within the broad dark bands.

Some improvement in the quality of the lines is obtained if both the standard and the unknown are covered with a uniformly thin coat of highly reflecting metal, such as silver or aluminum. This makes the lines thinner. The resulting narrow-line fringes are dark by reflected light or bright against a dark background with transmitted light. With modern methods of metal deposition and with smooth surfaces that are almost parallel to each other, fringes can be obtained whose widths are only one-fiftieth part of their separation. With such



Figures 1 and 2. Contour maps of precise optical surfaces have been prepared by interpolating additional fringes between the half-wavelength fringes of the usual interferometer pattern. Fringe movement is accomplished by varying the pressure and therefore the index of refraction of the air between the two surfaces, thus changing their optical separation. Figure 1: Interference pattern of an optical flat (separation of lines, one-half wavelength; contour interval, 0.00001 inch), indicates an excellent surface, slightly rounded at the edges, but with other departures from planeness not exceeding 1/10 wavelength. Figure 2: Portion of the same surface, greatly magnified and with 15 lines introduced between each 2 lines of the original (contour interval 1/30 wavelength or 0.0000006 inch). (Photos awarded second prize in the Fourth Annual International Photography-in-Science Salon, sponsored by the American Association for the Advancement of Science and the Smithsonian Institution.)

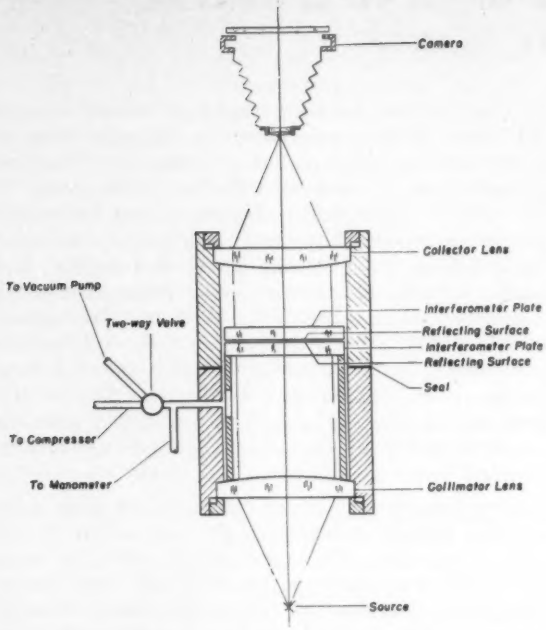


Figure 3. Schematic diagram of the special vacuum-tight interferometer, designed at the National Bureau of Standards for making the contour maps.

narrow fringes, deviations can be measured to better than 1/100 wavelength. This still does not reveal surface defects that may appear in the areas between the half-wavelength lines.

A method has now been worked out at the Bureau by which additional lines are placed between each of the half-wavelength lines. As many as 15 have been added in this way, thus reducing the spacing between lines (contour interval) to 1/30 wavelength, or 6 ten-millionths of an inch. This results in a much more complete map and brings out those details of the surface that are not shown with the wider interval.

The position of the interference lines can be changed by increasing or decreasing the optical separation of the two surfaces. If this separation is varied in uniform increments and successive exposures are made of the fringes in each of the resulting positions, a series of lines representing equal contour intervals is obtained. By choosing the increment properly, the space between two half-wavelength lines can be exactly divided into any desired number of contour intervals. The result is a complete contour map of the surface being examined. When a fringe has moved completely through the half-wavelength interval and reaches the position originally occupied by its neighbor, a double exposure is produced. These heavier, double-exposed lines serve as convenient references to indicate the absolute separation of the plates.

The method that has been used at the Bureau for controlling optical separation of the interferometer plates is to vary the density of the air. This is accomplished by enclosing the plates in an air-tight chamber and changing the pressure in equal increments. The exact amount of each increment can be computed from the wavelength of the monochromatic light, the index of refraction of the gas in the chamber, and the total pressure differential of the system.

For this particular work, the green line of mercury was selected and air was used in the chamber. A constant temperature of 25°C. was maintained, and the pressure could be varied from 0 to 760 millimeters (1 atmosphere). At this temperature the density of air is directly proportional to the pressure, within a close approximation. Therefore, to divide the space between two half-wavelength lines, for example, into eight equal contour intervals, the necessary pressure change for each additional line was 1/8 atmosphere, or 95 millimeters.

The apparatus consists of two cylindrical drums that can be bolted together to form a pressure-tight seal. A collimator lens sealed into one cylinder forms the lower window, and a collector lens in the other cylinder forms the upper window of the chamber. A gas line, connected to a manometer through a 2-way stop cock, permits either compression or evacuation of the gas within the chamber. The camera is focused on the interferometer plate and photographs the successive positions of the lines as they move across the plate.

A typical map prepared in this way has revealed patterns on the surface of a polished specimen arising from the particular stroke and polisher employed in finishing the surface. Although the conventional half-wavelength photographs showed some irregularities, these could not be correlated to give a complete picture of the shape of the surface. Seven additional fringes, however, very clearly pointed out the circular character of the pattern.

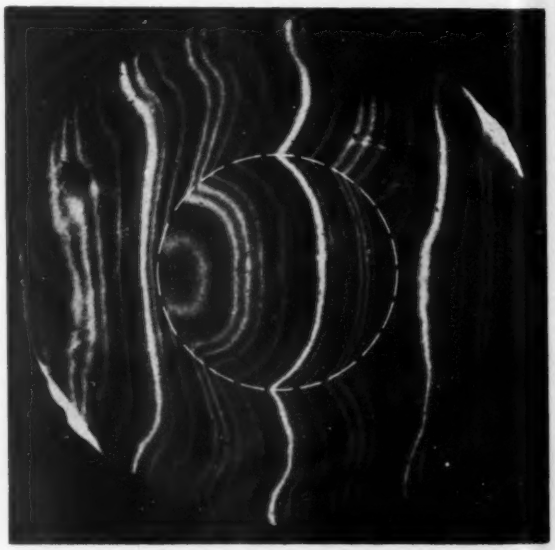


Figure 4. In the conventional optical method of testing a precision surface, the interference fringes correspond to differences in elevation of one-half wavelength. Three of these fringes appear in the illustration (slightly heavier, more intense lines). However, seven additional fringes have been introduced between each half-wavelength fringe by reducing in stages the pressure of the air between the surfaces. The result is in effect a contour map having a contour interval of approximately 1/16 wavelength, or 0.000001 inch. It is practicable to reduce the contour interval to a much smaller value. The "hill-and-valley pattern" reveals a pronounced circular zone which can be interpreted in terms of the strokes used on the polishing machine.

It was then possible to alter the polishing technique in order to obtain a smooth surface. Maps of this type might also reveal other irregularities in a polished surface, such as those caused by small particles of polishing material. The method can therefore be used to control a polished surface to a final accuracy limited only by the number of fringes that can be interpolated between two half-wavelength fringes.

SMALL CONTINUOUS FURNACE FOR FIRING PRINTED CIRCUITS

A small continuous-belt furnace has recently been designed and constructed by R. L. Henry and associates of the National Bureau of Standards engineering electronics laboratory. Smaller than commercially available continuous furnaces, such as those used in the glass industry, the new furnace is well suited for quantities somewhat too large to be efficiently handled by batch-type furnaces. While the unit was designed primarily for firing printed circuits, to meet the needs of the printed circuit program sponsored at NBS by the Navy Bureau of Aeronautics, it could be equally valuable for firing or annealing moderate quantities of other materials, particularly in laboratory or pilot-plant installations.

A silver paint is used at NBS for printing electronic circuits. This printing fluid consists of finely-powdered metallic silver, a suitable organic vehicle and solvent, and a flux. After a circuit pattern has been printed on a glass or ceramic plate by a stenciled screen process, the plate must be fired. The firing operation drives off the vehicle and solvent, activates the flux, and causes a partial sintering of the silver particles. The result is a firmly-bonded metallic film of high conductivity. Although a batch-type furnace is adequate if only a few plates are being fired daily, a continuous furnace is more satisfactory for somewhat larger outputs.

The operation of the NBS furnace is quite simple. A continuously-moving horizontal metal belt carries the material to be fired into the furnace at one end and delivers the fired product at the other end. Temperature and belt speed are adjustable over a wide range. Normally, however, printed plates are fired at 1350°F. and spend 65 minutes in transit from cold input to cold output. Flat plates can readily be stacked six deep on the 4-inch-wide belt. This gives a firing capacity of about 800 sq in/hr at the usual belt rate.

The furnace proper is a tunnel, 31 inches long, with walls of insulating brick. A guillotine-type door at the input end of the tunnel is adjustable to the height of the load, while at the output end the load pushes through an asbestos curtain. The temperature rises gradually from the two ends of the furnace to a region of maximum temperature in the center. Three Nichrome-coil heating elements embedded in refractory cement are arranged to give this gradual rise, the center element being adjusted to a higher temperature than the two that flank it. The temperature of the central region can be controlled thermostatically to within 7 degrees of any temperature up to 2000°F.

The continuous belt, woven of a high-temperature alloy, adequately resists corrosion at the furnace temperatures. An electric motor drives the belt through a speed-reducing train of gears, belts, and cone pulleys. Suitable rearrangements of the train permit firing cycles ranging from 25 minutes to 265 minutes.

The continuous furnace has proved highly useful in the NBS printed circuit laboratory. The furnace affords firing capacity fully adequate to the laboratory's needs, whereas the combined capacity of seven batch-type furnaces previously in use proved frequently inadequate. Yet floor space requirements are modest: 26″ x 54″. Utility of the furnace is enhanced by an automatic timer to turn it on at the beginning and off at the end of the working day.

PITTSBURGH CORNING PLANT EXPANSION AT PORT ALLEGANY, PA.

A new 20,800 square foot building is being erected by the Pittsburgh Corning Corporation at their Port Allegany, Pennsylvania Glass Block and Foamglas Insulation plant. The new building will house the company's Research and Development Division and Engineering Department, and will provide space for a machine shop and additional storage facilities.

The new building is being designed by architects Lacy, Atherton, and Davis of Wilkes-Barre and Harrisburg, Pa., and being constructed under the supervision of the Sordoni Construction Company, Forty-Fort, Pa. Many modern features will be used in the construction of the building. Of special interest is the use of prefabricated cellular glass insulated sandwich wall units, consisting of two veneers of concrete with a core of PC Foamglas, a cellular glass insulation manufactured by the company's Port Allegany plant. The roof of the building is also being insulated with Foamglas.

Another design feature of the new building is the use of functional light-directing glass blocks over a clear glazed vision strip. This type of fenestration has gained wide acceptance in schools, as well as industrial plants and office buildings, because of its ability to provide an abundance of evenly diffused daylight. Other interesting details in the new building are interior glass block partitions, flat native sandstone about the entrance and in the lobby, Herculite glass doors, native flagstone floors and wood paneling.

J. P. Staples, Executive Vice President of the Pittsburgh Corning Corporation, announced that the new building will be completed in October.

BAUSCH & LOMB ADDS TO RESEARCH STAFF

Announcement has been made that G. Sherwood Smith, a graduate in Ceramic Engineering of Iowa State College, has joined the Glass Section of the Chemical Research Laboratory of the Bausch & Lomb Optical Company. In his new position, Mr. Smith will study optical and radiation properties of new experimental glasses in less explored composition fields.

TEMPERATURE INDICATING PAINTS AND THEIR USE

One of the problems of industries like the glass industry where various sorts of temperature measurements must be made is that of measuring or determining the approximate temperature of places or objects that are inaccessible to the usual types of temperature measuring equipment. In such cases the wish has often been made that it would be helpful if one could just look at the surface in question and see its temperature or its temperature pattern.

This problem and wish has been answered. Temperature sensitive paints have been developed to serve the needs of industry for the first time since World War II's end. With these paints, the entire surface of an engine or similar piece of equipment may be painted with a particular color. An irreversible change of color indicates when the temperature of the entire surface, or any part thereof, has attained or exceeded a predetermined value. In some cases, the result may look like a combination rainbow and the isobars on a weather map. Such a pattern gives information on the temperature of the entire surface at a glance.

These paints, originally a product of I. G. Farbenindustries, are distributed in the United States by the Tempil Corporation and come in 15 basic shades. The reference number, the basic color, the color changes, and the temperature equivalents are shown in Table I.

TABLE I

Reference No.	Color and Color Change	Temperature °F
G87	Pink	
	Lavender	176
	Light Brown	563
E102	Pink	
	Blue Violet	239
	Gray	590
GG55	Mauve Pink	
	Bright Blue	284
	Gray	599
G97	Blue	
	Dark Green	320
G69	Light Tan	
	Bronze Green	302
	Deep Purple Brown	464
	Pale Indian Red	590
E94	Bright Violet Blue	
	Bright Green	311
	Olive Green	446
	Dark Gray	545
	Light Gray	554
	Light Brown	572
	Buff	644
E106	Reddish Orange	
	Brick Red	401
	Brown	446
	Almost Black	473
	Medium Gray	563
	Dirty White	635
G75	Light Blue	
	Fawn	410
F41	Ochre Yellow	
	Brick Red	437
E104	Greenish White	
	Gray	455
E93	Gray Blue	
	Buff	527
	Creamy White	554
E6	Scarlet	
	Brick Red	545
	Gray Brown	698
	Yellow	824
	Orange	1157
F21	White	
	Brownish Yellow	608
E59	Mauve	
	Fawn	752
	Gray	959
	White	1040
G6	Red	
	Brown Gray	770
	Yellow	914
	Orange	1067
	Green	1472

The main constituents of the paints are compounds of cadmium, cobalt, nickel, copper and manganese, a suitable pigment such as titanium dioxide and a substance called plastopal which is a 50 per cent solution urea-formaldahyde resin in butyl alcohol. To obtain spraying or brushing consistency, the paints are reduced with ethyl alcohol—usually 100 parts of color paste to 60 or 80 parts of alcohol.

These temperature indicating paints are finding many uses, particularly in applications where thermocouples or thermometers cannot be utilized. For example, one use is in the study of cooling processes for air-cooled internal combustion engines. Here the paints are used to assist in determining proper locations for thermocouples to measure internal heat while the engine is in operation. Without application of one of the paints, placing of thermocouples may distort air currents around the test engine sufficiently to affect the accuracy of the measurements. The painted spots also assist in indicating the heat transfer qualities of the lubricants, as well as the efficiency of the air-cooling arrangements.

Other uses for the paints have been suggested: In heat treatment processes, a useful check is given by painting a spot of the appropriate paint on the article undergoing treatment. This provides, by a change of color, positive proof that the article had been through the oven. This usage, if adopted by the supplier of glass mold irons, would guarantee the glass container manufacturer that his alloyed cast-irons had been properly heat-treated.

In the hot working or local heat treatment of light alloys, two spots of the most suitable paints, side by side,

(*Continued on page* 426)

Inventions and Inventors

Feeding and Forming

Bottle Forming Machine. Patent No. 2,554,545. Filed Feb. 21, 1948. Issued May 29, 1951. Two sheets of drawings, none reproduced. One-half interest assigned to Henry C. Daubenspeck by Samuel E. Winder.

This invention provides an adjustable cam mechanism for bottle machines and the like, which can be adjusted while the machine is in operation. The drawings show a cam mechanism used in connection with a transfer mechanism, but it can well be applied to other mechanisms in a forming machine. Reference is made to a copending application on which this invention is an improvement. By this device, minute and accurate adjustments in the timing of any cam-operated part of a forming machine may be made while the machine is running.

The patent contains two claims and the references cited were 1,684,064, Miller, Sept. 11, 1928; 2,207,629, Mitchell, July 9, 1940; and 2,450,311, Strunk, Sept. 28, 1948.

Mold Setting Jig. Patent No. 2,557,322. Filed Sept. 15, 1948. Issued June 19, 1951. Two sheets of drawings, none reproduced. Assigned to Emhart Manufacturing Company by William H. Storrs.

This invention is a jig for setting the blank and blow molds of a Hartford I.S. machine so that they will cooperate properly when they are installed in the machine. It is a set-up tool rather than a glassworking implement. This device should be of interest to all users of I.S. machines.

The patent contains four claims and the only reference cited was Ingle, No. 1,911,110, dated May 23, 1933.

Suction Feeding Improvement. Fig. 1. Patent No. 2,559,467. Filed April 19, 1949. Issued July 3, 1951. C. H. A. Salgueiro dos Santos Gallo, inventor, Marinha Grande, Portugal.

The invention is intended to replace the revolving pot as sometimes used with an Owens machine. A floating partition B has one end set into the furnace wall C and the other end extends into a supplemental reservoir A. A paddle D causes the hot glass to circulate as indicated by the arrows.

The patent contains two claims and the references cited were 1,927,101, Stenhouse, Sept. 19, 1933; 1,959,417, Flexon, May 22, 1934; 2,154,535, Schutz, Apr. 18, 1939; 2,191,733, Tremblay, Feb. 27, 1940; and 315,345, Great Britain, Oct. 31, 1929.

Glass Compositions

Decorating Enamel. Patent No. 2,557,545. Filed Feb. 15, 1949. Issued June 19, 1951. No drawings. Assigned to Johnson, Matthey & Company by Frank E. Kerridge, both of London, England.

This enamel is intended for use in the decoration of glassware and particularly with the silk-screen process. The patent gives full directions for practicing the invention, which is covered by 20 claims. The invention is defined in one of the claims as a method of making a vitrifiable enamel for the decoration of glass, which comprises the steps of (1) preparing a flux mixture having the following composition in the following proportions,

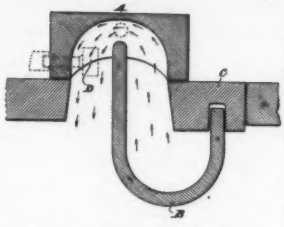


Fig. 1. Suction Feeding Improvement.

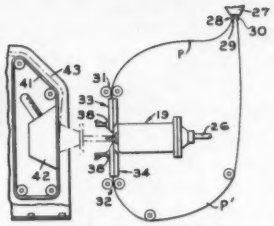


Fig. 2. Method of Making Fibers.

namely: lead monoxide (PbO) 64.9%, silica (SiO_2) 26.2%, boric oxide (B_2O_3) 5.2% and soda (Na_2O) 3.7%, (2) melting the mixture at red heat and grinding in with 95.5 parts of the resultant fritted flux, 4.5 parts of molybdic oxide and 5 parts of ceric oxide.

The references cited were 2,267,928, Kreidl, Dec. 30, 1941; 85,519, Switzerland, 1920; and Ser. No. 335,627, Paquet (A. P. C.), published June 1, 1943.

Glass Wool. Patent No. 2,557,834. Filed Feb. 23, 1949. Issued June 19, 1951. No drawings. Assigned to The Carborundum Company by John C. McMullen.

The patent contains four examples of a batch for making glass wool and 15 claims, the last of which defines the invention as follows: A raw batch for making glass wool comprising 45-55 parts by weight of alumina, 55-45 parts by weight of silica, and 1½ to 6 parts by weight of a modifying agent selected from the group consisting of borax glass and compounds of boron and sodium equivalent thereto.

The only reference cited was 2,394,493, Schoenlaub, Feb. 5, 1946.

Opal Glass. Patent No. 2,559,805. Filed July 3, 1947. Issued July 10, 1951. No drawings. Assigned to Corning Glass Works by Stanley D. Stookey.

The patient gives eight examples of compositions coming under this patent. Composition 7 is particularly adapted for tank melting and is suitable for hand or machine working. The examples expressed by weight as calculated from their batches are as follows:

	1	2	3	4	5	6	7	8
SiO_2	60	50	55	65	70	67	57	55
Na_2O	10	15	14	15	10	10	10	13
BaO	10.5	13.5	19	14	7	13	13	14
P_2O_5	4.5	6.5	9	6	3	5	5	8
B_2O_3	10	15	1.5	..	10	..	7	5
Al_2O_3	5	..	1.5	..	..	5	8	5
BaO/P_2O_5	2.3	2.1	2.1	2.3	2.3	2.6	2.6	1.75
R_2O/P_2O_5	2.2	2.3	1.5	2.5	3.3	2.0	2.0	1.6
$R_2O/BaO+P_2O_5$	.67	.75	.5	.75	1.0	.55	.55	.59

The patent contains seven claims and the references cited were 2,394,502, Weyl et al., Feb. 5, 1946; 166,672, Germany, 1905; 186,423, Germany, 1907; and 580,027, Great Britain, 1946.

Glass Wool and Fiber

Method of Making Fibers. Fig. 2. Patent No. 2,559,572. Filed April 30, 1947. Issued July 3, 1951. Two

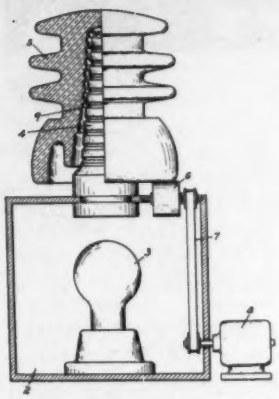


Fig. 3. Insulator Inspecting Device.

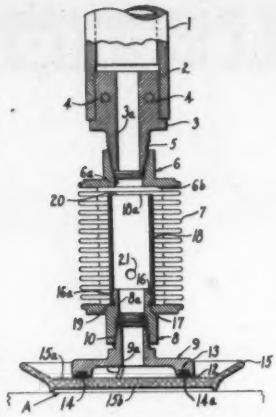


Fig. 4. Vacuum Transfer Device.

sheets of drawings. Assigned to Owens-Corning Fiberglas Corporation by Charles J. Stalego.

The figure is a diagrammatic view showing a burner 19 supplied with gas by a pipe 26. A blast of high temperature and high velocity is discharged from the outlet of the burner. Primary filaments P and P′ are delivered from a row of orifices 28 in a glass feeder 27 and around guide rolls to feed rolls 31 and 32 and then to upper and lower water-cooled guides 33 and 34. These guides direct a row of primary filaments into the blast from the burner 19, the upper and lower filaments being in staggered relation.

By this construction, a series of very fine fibers is discharged against a conveyor 41 where a unitary mat 43 is formed. A suction chamber 42 is provided.

The patent contains 16 method and apparatus claims and the references cited were 1,128,175, Morf, Feb. 9, 1915; 1,157,984, Herkenrath, Oct. 26, 1915; 2,405,036, Hoffman, July 30, 1946; 2,450,363, Slayter et al., Sept. 28, 1948; and 2,457,777, Holtschulte et al., Dec. 28, 1948.

Sheet and Plate Glass

Cutting Sheets from a Continuous Sheet. Patent No. 2,560,305. Filed Oct. 26, 1948 (in France, Oct. 29, 1947). Issued July 10, 1951. Five sheets of drawings, none reproduced. Assigned to Societe Anonyme des Manufactures des Glaces et Produits Chimiques de Saint-Gobain, Chauny & Cirey, Paris, France, by Michel H. M. L. Ramain, St. Ingbert, Territory of the Saar.

This machine takes an upwardly moving sheet of glass as it comes from the bath, scores a scratch across the sheet, then turns the sheet into a horizontal plane and breaks it at the score. The severed sheet is then grasped by tongs and carried across a table on which it is accurately positioned. Cutters then sever the sheet into the desired sizes. The whole mechanism is electrically controlled and all necessary adjustments are provided for.

The patent contains 19 claims and the references cited were 1,996,387, Owen, Apr. 2, 1935; 2,111,393, Gaskell, Mar. 15, 1938; and 342,304, Italy, 1936.

Miscellaneous Processes

Insulator Inspecting Device. Fig. 3. Patent No. 2,552,522. Filed June 18, 1947. Issued May 15, 1951. One sheet of drawings. Assigned to Armstrong Cork Company by E. D. Counsellor.

This invention is particularly useful in inspecting amber insulators. The drawing is practically self-explanatory. The insulator is rotated around a core 4 of "Plexiglas" or "Lucite." Light from the bulb 3 passes through the core and the efficiency is increased by grooves 9.

The patent contains five claims and the following four references were cited: 1,539,626, Bartlett, May 26, 1925; 2,247,258, Shepard, June 24, 1941; 2,247,737, Weeks, July 1, 1941; and 2,468,663, Green, Apr. 26, 1949.

Vacuum Transfer Device. Fig. 4. Patent No. 2,557,260. Filed Oct. 17, 1946. Issued June 19, 1951. One sheet of drawings. Assigned to Emhart Manufacturing Company by Stanley P. Clark.

A tube 1 is carried by a stacker arm, for example, such as shown in Patent No. 1,878,156. A flexible connection is made by a "Sylphon" 7 with a suction head 9 having a washer 14 to make an air-tight connection with an article such as the saucer 15. When the head 9 is lowered into contact with the article, the "Sylphon" 7 may be compressed and it will yield laterally to permit the head to make a flat contact with the ware. The inside of the tube is connected with a source of vacuum which is turned off and on at the proper times. Thus flat ware can be picked up even if not in exact position and not perfectly level.

The patent contains three claims and 10 references.

Breaking Scored Sheets. Fig. 5. Patent No. 2,559,306. Filed March 26, 1949. Issued July 3, 1951. Two sheets of drawings. Assigned to Libbey-Owens-Ford Glass Company by Joseph R. Morris.

This machine is for the purpose of breaking off the waste edges of glass sheets which have previously been scored by hand or by an automatic template cutting machine, such as wind shields for automobles. The scored sheet 25 is placed on a belt 20 and is engaged by rollers to keep it in position on the belt. As the sheet advances it engages electrical switches which cause strikers 49 to strike blows on the waste margin 31 outside the score line 30 while the sheet is in position over a pad 57. This causes the waste to break off. The finished sheet 25 is then lifted slightly so that it can be easily picked up and removed by the operator.

Various adjustments are provided so that different shapes can be broken out. The patent contains two claims and the references cited were 791,827, Semmer, June 6, 1905; 1,220,201, Danner, Mar. 27, 1917; 1,324,219, Waterloo, Dec. 9, 1919; and 2,259,765, Morris, Oct. 21, 1941.

Straightening Stems on Glassware. Patent No. 2,553,358. Filed Dec. 31, 1948. Issued May 15, 1951. Two sheets of drawings none reproduced. Assigned to A. H. Heisey & Co., by Ray C. Cobel.

The article is shaped on a blow pipe in the usual manner and the stem is attached by the usual pressing operation. The blow pipe is then rotated while the stem is supported by a form of carbon material. This straightens the stem which is then ready to have the foot attached.

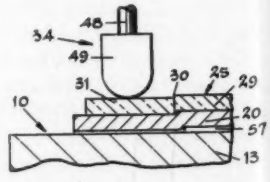


Fig. 5. Breaking Scored Sheets.

The patent contains three claims and the following references were cited: 205,781, Atterbury, July 9, 1878; 346,181, Walton, July 27, 1886; 580,716, Proeger, Apr. 13, 1897; 588,319, Brooke, Aug. 17, 1897; 1,436,825, Sanford, Nov. 28, 1922; 2,156,613, Wohinc, May 2, 1939; and 713,217, France, Oct. 23, 1931.

Sealing Fixture. Patent No. 2,553,749. Filed May 5, 1948. Issued May 22, 1951. Two sheets of drawings, none reproduced. Assigned to Bell Telephone Laboratories, Inc., by J. E. Clark and V. L. Ronci.

This device is useful in making the glass-to-metal seals common in ultra-high frequency electronic devices such as shown in Patent No. 2,405,611 to Samuel. The object of this invention is to provide a fixture for holding the parts during and prior to the sealing operation, so that the parts will be very accurately positioned, well sealed, and all this at a high speed calling for no skilled labor.

The patent contains four claims and the references cited were 1,562,533, Weintraub, Nov. 24, 1925; 2,297,492, Michaelis, Sept. 29, 1942; 2,374,546, Laico, Apr. 24. 1945; 2,386,820, Spencer, Oct. 16, 1945; 2,415,412, Buchwald et al., Feb. 11, 1947; 2,422,628, McCarthy, June 17, 1947; and 2,488,302, Machlett et al., Nov. 25, 1949.

Tempering Apparatus. Patent No. 2,553,945. Filed Aug. 4, 1941. Issued May 22, 1951. This patent expires July 13, 1959. Two sheets of drawings, none reproduced. Assigned to American Securit Company by J. L. Schrader, Lyon, France.

This patent contains one claim which is as follows: In a device for tempering glass sheets, the combination of heating furnace for the glass, cooling heads, an envelope capable of enclosing the glass, an envelope heating chamber and means for shifting the heated glass from the furnace into the envelope, moving the envelope with the enclosed glass to a position between the blowing heads and for moving the envelope from around the sheet while between the blowing heads into the envelope heating chamber.

The Patent Office cited 17 references.

Tube Sealing Apparatus. Patent No. 2,554,503. Filed July 13, 1945. Issued May 29, 1951. Two sheets of drawings, none reproduced. W. T. Rainey and J. A. Krynitsky, United States Navy, inventors.

The tubes formed by this machine may be used in the detection of certain gases in which case detector gels are placed in a tube the ends of which are then sealed. In use, the ends are broken so as to expose the gel to the surrounding atmosphere.

The machine comprises a hopper from which the tubes are delivered one at a time to a sealing station where one end of the tube is heated and sealed while rotating. The tube then moves to a second station where the other end of the tube is sealed. The tube then goes to a delivery station.

The patent contains six claims and references were cited as follows: 1,455,056, Koenig, May 15, 1923; 1,489,837, King, Apr. 8, 1924; 1,674,636, Cameron, June 26, 1928; 1,844,869, Hauger et al., Feb. 9, 1932; 1,949,119, Gibbs, Feb. 27, 1934; 1,976,239, Lorenz et al., Oct. 9, 1934; 2,077,827, Dichter, Apr. 20, 1937; 2,234,302, Dichter, Mar. 11, 1941; and 529,324, France, Sept. 7, 1921.

Paste Mold. Patent No. 2,555,712. Filed Jan. 8, 1949. Issued June 5, 1951. No drawings. Assigned to Corning Glass Works by Rowland D. Smith.

This patent gives directions for practicing the invention with automatic machines, semi-automatic machines, and hand operation.

The patent contains seven claims, the last of which is as follows: In the method of shaping hot plastic glass in a paste mold having a porous, carbonaceous, glass-contacting surface wherein the alternate and repeated operations of shaping glass within the mold and applying cooling water to the mold surfaces including the glass-contacting surface thereof are performed, the step of applying an aqueous solution of a cold water-soluble cellulose ether in place of such water at spaced intervals.

The references cited were 2,246,463, Garratt, June 17, 1941; 2,328,333, Freeman et al., Aug. 31, 1943; 2,376,244, Freeman et al., May 15, 1945; 2,410,422, Breene et al., Nov. 5, 1946; and Glass the Miracle Maker, by Phillips, Publ. by Pitman Publ. Corp., N. Y., 1941, Pages 167 and 168.

Ware Handling Apparatus. Patent No. 2,556,469. Filed March 19, 1948. Issued June 12, 1951. Three sheets of drawings, none reproduced. Assigned to Emhart Manufacturing Company by Francis A. Dahms.

This invention provides a device by which bottles or the like, which are made two at a time, are moved to two successive cooling stations on a dead plate to which they have been delivered by the take-out. The bottles are then moved onto a conveyor. The invention is an improvement over a pending application by Worrest filed June 30, 1947. It is particularly adapted for use with the Hartford I. S. Machine.

The patent contains 10 claims and references cited by the Patent Office were: 1,921,390, Ingle, Aug. 8, 1933; 1,974,837, Shillinger et al., Sept. 25, 1934; 2,180,737, Hess, Nov. 21, 1939; 2,182,167, Berthold, Dec. 5, 1939; 2,282,848, Berthold, May 12, 1942; 2,284,796, Berthold, June 2, 1942; 2,340,729, Barker, Jr., Feb. 1, 1944; and 2,413,722, Long, Jan. 7, 1947.

Zircon Refractory. Patent No. 2,553,265. Filed Nov. 6, 1947. Issued May 15, 1951. No drawings. Assigned to Corning Glass Works by John M. Mochel.

This refractory is adapted for use in contact with molten glass. One of the three claims for the patent sets forth the method of making a refractory from finely pulverized zircon containing free SiO_2, which comprises preparing a mixture consisting essentially of such zircon, finely divided ZrO_2 in substantially the stoichiometric proportion to form $ZrSiO_4$ with the free SiO_2, about 1% of finely divided TiO_2, and about 1% of a finely divided oxide of manganese computed as MnO, forming a slip from such mixture, molding the slip to form a body of desired shape, and firing the shaped body at a temperature of at least 1500° C.

The references cited were 1,816,006, Easter, July 28, 1931; 2,267,772, Wainer et al., Dec. 30, 1941; and 2,338,209, Smith, Jan. 4, 1944.

Method of Coating Glass. Patent No. 2,557,786. Filed originally June 11, 1943. Divided June 12, 1947. Issued June 19, 1951. No drawings. Assigned to Corning Glass Works by Oscar K. Johannson.

(*Continued on page* 430)

GbG

(glass batch gypsum)

Glass batch gypsum—not new as a glass batch ingredient, but for the first time actually "designed" for maximum efficiency as a refining agent.

Aside from its inherent properties which in actual use have proven gypsum a most desirable product as a source of sulphate, we now offer glass batch gypsum ($CaSO_4.2H_2O$) designed in grain size to match the average size of other major raw materials.

Coupled with its natural free flowing characteristics, this special processing obviously contributes greatly toward perfect batch blending.

Other important values offered by GbG as a sulphate bearing material are: uniformity of SO_3, minimum refractory attack, minimum selenium volatilization, low iron content, dependability of supply (particularly important today), and low cost.

Write for full particulars.

The Calumite Co.
HAMILTON, OHIO

NATIONAL LEAD ACQUIRES CHAS. TAYLOR SONS COMPANY

National Lead Company has announced the acquisition of all the capital stock of Charles Taylor Sons Company, manufacturers of specialized refractory materials. The concern will be operated as a subsidiary under its present management, with head offices and a plant in Cincinnati and another plant in Taylor, Kentucky.

National Lead Company has been interested for many years in the refractory field as a producer and refiner of zircon. The parent company has a refractory plant at Niagara Falls which is used to develop materials and methods for other refractory manufacturers.

Founded in 1864 to manufacture fire brick, the Charles Taylor Sons Company today produces various high-temperature refractory materials, mainly for the glass and metallurgical industries. Sillimanite, mullite, and zircon are the principal materials used for this purpose. Mullite has as its chief component kyanite, which is imported mainly from India. An outstanding achievement of the company has been the production of artificial mullite, suitable for use in highly efficient refractories and helping to eliminate the uncertainties of overseas supplies.

Officers of the Chas. Taylor Sons Company are C. R. Taylor, President and Treasurer; M. C. Booze, Vice President and Secretary; Robert W. Knauft, Vice President in Charge of Sales; and E. L. Bohn, Vice President in Charge of Production.

RECESS TAKEN IN GLASS TALKS

Negotiators seeking a new contract for 10,000 glass workers began a month's recess today after failing to reach agreement in nearly two weeks of conferences.

A spokesman for the AFL American Flint Glass Workers Union of North America said negotiations had been under way with representatives of the glass industry's automatic machine plants division, but "no success toward a real approach to an agreement."

The union spokesman admitted the National Association of Manufacturers of Pressed and Blown Glassware made a counter-proposal to the union's demand for a 20-cent-an-hour wage increase of 20 per cent, whichever is greater.

Before the talks resume August 16, the union will begin conferences with the Glass Container Manufacturers Institute in behalf of 1,500 workers in bottle plants. On July 31, the union also will begin negotiations on a new contract for 16,000 workers in hand and combination production plants.

In all, union and management groups will bargain for a total of about 35,000 workers employed in 40 glass plants, principally, in West Virginia, Ohio, Pennsylvania, Indiana, and New Jersey.

The present industry contract expires September 3.

PILKINGTON GLASS SCHOLARSHIP

The Pilkington Glass Scholarship, which is open to all graduating Canadian architectural students, has been won this year by H. P. V. Massey of the University of Toronto with his submission of a National Gallery.

The Scholarship will enable Mr. Massey to study in England and Europe for a year and is valued at $1500. plus all traveling expenses to and from England.

An Experimental Investigation of Alumino-Silicate Refractories of High Purity for Use in Glassmaking

A study has been made by Moore and Heeley (*Journal of the Society of Glass Technology*, December 1950) of the corrosion resistance of refractories of high purity when exposed to molten glass of ordinary colorless bottle glass composition (SiO_2 73.25, R_2O_3 1.00, CaO 9.05, MgO 0.55, Na_2O 16.15).

The refractory mixtures were made from kaolin, alumina, and silica in various proportions. The composition of these materials is shown in Table I.

TABLE I
Analysis of the Raw Materials Used

	Kaolin $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	Calcined Alumina Al_2O_3	Flint SiO_2
SiO_2	47.4	—	99.7
Al_2O_3	38.7	99.6	—
Na_2O	0.16	trace	—
K_2O	0.43	—	—
TiO_2	*	—	—
Fe_2O_3	0.47	0.1	0.3
Water	13.5	0.3	—

* Could not be detected.

In one or two cases, burnt kaolin (Molochite) was used in place of some of the raw kaolin, and in one series, sillimanite was used as the "grog."

The compositions were varied to give alumina/silica ratios ranging from 30:70 to 80:20. For most of the experimental refractories, the grog was prepared by firing a suitable mixture of the raw materials, the grog being subsequently bonded by a similar mixture. The proportions of grog and bonding mixture were varied, the proportion of kaolin in some of the mixtures being 40 per cent and in the others, 35 per cent.

The shrinkages during firing and the apparent porosities of all the fired refractories were determined. The effects on porosity produced by firing to different temperatures and by holding the mixtures at particular temperatures for longer or shorter times were also studied.

Various methods have been used by different workers to obtain comparative values for the corrosion-resistance of different refractories. The value of any such test depends primarily on how accurately the results can be used to predict the relative amounts of corrosion which the different refractories would suffer when used in glass melting. In devising a corrosion test, therefore, it is necessary to ensure that the test pieces shall all be exposed under similar conditions to the corrosive action of the glass, and that the conditions shall cause corrosion to occur in the same way as at the surface of a tank block or pot in a glass melting furnace. The test must also enable the corrosion to be measured by some reasonably accurate and sensitive method.

In a tank or pot, convection currents in the glass cause some flow of the glass over the surface of the refractories, thus causing the solution products to be removed at a rate depending upon the velocity of the currents and on the viscosity of the layers of glass on the refractory surface. In any corrosion test, therefore, the test specimens should be so situated that the solution products can be removed from the immediate vicinity of the surface of the specimen by being carried away either by convection currents or by mechanical movement of the specimens through the glass. An important consideration is that definite and reliable measurements of the corrosion should be obtainable in as short a time as possible, at the minimum cost for equipment, fuel, and labor. The method should also provide for the testing of a number of comparatively small specimens at the same time.

For these reasons, the method of test decided upon by the authors was to suspend cylindrical test pieces in molten glass and to determine the corrosion after some definite period, provision being made for moving the specimens slowly through the glass if desired. Using this method, the corrosion resistance of the experimental refractories was compared by measuring the extent to which cylindrical test specimens were corroded after partial immersion in molten glass at 1400°C. and 1500°C. for periods of 10 hours. To determine the effect of grog size on corrosion resistance, tests were made using mixtures containing different grog gradings, but otherwise identical.

It was concluded that the results of this work show what is already well known; namely, that the properties of refractory materials depend upon composition (chemical analysis), apparent porosity, permeability (to molten glass), temperature, and duration of firing of the refractory mixture. They also show, however, that the resistance to corrosion by molten glass cannot be related in any direct or generally applicable way with (a) over-all composition such as would be revealed by chemical analysis, (b) apparent porosity, and (c) permeability to molten glass.

On the other hand, corrosion resistance is, in general, increased by (a) the use of fine-grained, as compared with coarse-grained, grog, provided that the grog has been sufficiently hard-burned, but not otherwise, and provided also that the refractory has been adequately fired, (b) using smaller proportions of raw clay to grog, and (c) firing the refractory at a sufficiently high temperature for a sufficient time. High firing is particularly important for mixtures containing high proportions of alumina.

The resistance to corrosion by molten glass depends in a complex manner on all the factors mentioned, and certain of these cannot be determined by reasonably simple methods of examination of the refractory itself. Any specification in which limits were given for those properties which can readily be determined by examination of a refractory could, therefore, be very misleading and it would appear that a "performance specification" would be in every way preferable.

It is suggested by the authors that, in drawing up such a performance specification, the method of test used in

(*Continued on page* 431)

A test sealing of a facsimile of the Declaration of Independence is made at the National Bureau of Standards in preparation for the encasement of the original document on Constitution Day, September 17, 1951. In this first step, backing paper of pure cellulose is centered on the bottom panel of tempered glass. The paper serves as a protective cushion for the document and as a reservoir of moisture to prevent excessive changes in relative humidity inside the enclosure. Left to right are Dr. Roy W. Wampler, Assistant Director of Research of Libbey-Owens-Ford Glass Company; Alvin W. Kremer, Keeper of the Collections at the Library of Congress; and Dr. G. M. Kline, Chief of Plastics Section of the National Bureau of Standards.

DECLARATION OF INDEPENDENCE AND U. S. CONSTITUTION TO BE PRESERVED IN GLASS

The Declaration of Independence and the Constitution of the United States are to be hermetically sealed in helium-filled glass enclosures designed to preserve them safely for as long as man can foresee. Plans for preserving the original engrossed and signed manuscripts are the result of studies and experiments made during the last ten years by the National Bureau of Standards at the request of Luther H. Evans, Librarian of Congress.

In accordance with the Bureau's recommendations, the four leaves and the letter of transmittal of the Constitution and the leaf of the Declaration of Independence are to be sealed in air-tight envelopes, each envelope consisting of two panes of glass bonded to a metal frame. Each document leaf will have its own enclosure and will rest upon special pure cellulose backing paper in an inert atmosphere of 99.99% pure helium having a controlled humidity. The enclosures will be exhibited in the shrine at the Library of Congress behind special filters which will shield the parchments from destructive light rays.

In its study, the National Bureau of Standards determined that double-glazed panels made commercially as insulating windows would meet the requirements set up. Libbey-Owens-Ford Glass Company agreed to cooperate in the project by preparing Thermopane enclosures of the documents.

The enclosures consist of two rectangular panes of tempered plate glass separated 3/8 inch by a 1/16 inch thick lead strip which is set approximately 3/8 inch from the edges of the glass panes and which completely encircles the enclosure. The two panes of glass have a special metallic coating applied on them where they make contact with the lead strip. This coating makes it possible to bond the lead strip to the glass panes by solder thus completely sealing the interior cavity from the outside atmosphere. A bronze bracket 7/16 inch wide is inserted inside of the enclosure to frame the document completely and to hold in place the glass cover plate which rests on the document to keep it flat.

AMERICAN GLASSWARE JUBILEE

Attention will be focused sharply on U. S. automatically-made glassware this fall through a national "American Glassware Jubilee". The promotion will stress the advantages and superiority of domestic table, kitchen, and cooking glassware and their continuing availability in the face of shortages of certain other household items.

To be conducted during the week of October 7-13, "American Glassware Jubilee" will be sponsored by eight companies composing the machine table and kitchenware division of the American Glassware Association.

The theme, "Glassware for Gracious Living", is designed to aid the retailer in boosting both traffic and sales in his glassware department. The Jubilee will open with a special historical program at Sandwich, Massachusetts, where the first step toward mechanization of the American glass industry was taken 125 years ago.

A comprehensive merchandising, advertising, and publicity program has been developed for the Jubilee. The manufacturers will conduct their own advertising campaigns to stimulate public interest in the promotion. Company and distributor salesmen will be trained to help their customers plan and conduct their participation in the Jubilee.

The Jubilee will emphasize economy as well as the beauty, practicality, and versatility of automatically-made glassware, Association Secretary H. L. Dillingham pointed out. While the individual table and kitchen glassware manufacturers participating have, in the past, provided their customers with promotional helps, the Jubilee represents their first concentrated industry-wide program specifically designed to aid the retailer increase his sales.

The companies participating include Anchor Hocking Glass Corporation, Bartlett-Collins Company, Corning Glass Works, The Federal Glass Company, Hazel-Atlas Glass Company, Indiana Glass Company, The Jeannette Glass Company, and Libbey Glass Division of Owens-Illinois Glass Company.

WESTINGHOUSE GRANTS PAY RAISE

Westinghouse Electric Corporation has agreed to grant unions representing a majority of its employees a 9 cents an hour pay increase effective April 16, 1951. President Gwilyn A. Price announced that the action was made possible by the Wage Stabilization Board's approval of the increase request and by Congressional action forestalling price rollbacks.

No increase is contemplated in the price of Westinghouse products as a result of the wage and salary increase which will add $20 million a year to the company's business cost.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during May 1951 fell off to reach a preliminary 130,900. During April 1951, 131,900 persons were employed—a difference of not quite 1 per cent. Employment during May 1950 was 116,100, or about 12½ per cent less than for May this year.

Payrolls during May 1951 were reported at a preliminary $37,148,111. This figure represents a drop of about 2 per cent from the adjusted payrolls of $38,146,359 reported for April. During May 1950 payrolls had been $30,079,349, or close to 23½ per cent under May this year.

Glass container production, based on figures released by the Bureau of Census, levelled off a little during June 1951 and was reported to be 10,489,467 gross. Compared with the 10,849,205 gross produced during May, this represents a drop of a little more than 3 per cent. During June 1950 a total of 9,117,909 gross of glass containers were produced, or 15 per cent less than during June 1951. At the half-way mark in 1951, glass container manufacturers have produced a total of 62,880,085 gross. At the close of the same period in 1950, production had reached 50,403,644 gross, representing a difference of 24½ per cent.

Shipments of glass containers during June 1951 also fell off slightly to reach 10,148,644 gross. This represents a drop of 5 per cent compared with the previous month's shipments of 10,702,352 gross. Shipments during June 1950 were 9,343,593 gross, or about 8½ per cent below June this year. Total shipments of glass containers at the close of the 6-month period of 1951 have reached 59,713,475 gross. A comparison with the previous year's six-month shipment total of 49,668,461 gross shows that 1951 shipments are about 20 per cent ahead of 1950.

Stocks on hand at the close of June 1951 were 9,714,037 gross, which is 3 per cent more than the 9,426,382 gross on hand at the close of May. At the end of June 1950, stocks on hand were 9,374,511 gross.

Automatic tumbler production during June was 6,383,874 dozens, or 12½ per cent off from the previous month's production of 7,292,106 dozens. Production during June 1950 was 5,635,390 dozens. Shipments during June also dropped and were reported to be 5,736,905 dozens. Compared with May shipments of 6,759,720 dozens, a drop of 15 per cent for June is indicated. Shipments during June 1950 were 5,699,315 dozens. Stocks on hand at the end of June were 11,973,689 dozens, which is a little more than 5 per cent above May stocks of 11,381,190 dozens. At the close of June 1950 stocks on hand were 8,719,106 dozens.

Table, kitchen, and household glassware: Manufacturers' sales of machine-made table, kitchen, and household glassware were 2,682,232 dozens. This is a little more than 21 per cent below May sales of 3,407,828 dozens. During June 1950 manufacturers' sales were 3,117,022 dozens. At the close of the 12-month period ending June 1951, total manufacturers' sales have reached 46,725,738 dozens. Compared with the 38,764,788 dozens sold at the close of the corresponding period in 1950, sales for the 1951 period are 20½ per cent ahead of 1950.

GLASS CONTAINER SHIPMENTS
(All figures in Gross)

Narrow Neck Containers

	June 1951
Foods	908,249
Medicinal & Health Supplies	1,121,069
Chemicals, Household & Industrial	724,833
Beverages, Returnable	947,756
Beverages, Non-returnable	21,618
Beer, Returnable	753,563
Beer, Non-returnable	1,032,619
Liquors	507,022
Wines	223,410
Toiletries & Cosmetics	444,783
Sub-total (Narrow)	6,684,922

Wide Mouth Containers

Foods	2,289,335
Dairy Products	254,776
Home Canning	*
Medicinal & Health Supplies	263,103
Chemicals, Household & Industrial	98,485
Toiletries & Cosmetics	136,136
Packers' Tumblers	120,509
Sub-total (Wide)	3,162,344
Total Domestic	9,847,266
Export Shipments	301,378
TOTAL SHIPMENTS	10,148,644

* This figure included with "Wide Mouth Foods".

GLASS CONTAINER PRODUCTION AND INVENTORY
(All figures in Gross)

		Production June 1951	Stocks June 1951
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	3,473,590	3,486,381
	Wide Mouth	3,119,904	3,873,134
Dairy Products		265,380	286,610
Home Canning		*	*
Beverages, Returnable		937,567	599,846
Beverages, Non-returnable		18,537	23,738
Beer, Returnable		779,686	209,205
Beer, Non-returnable		1,021,085	170,523
Liquors		509,064	638,298
Wines		241,619	295,159
Packers' Tumblers		123,035	131,143
TOTAL		10,489,467	9,714,037

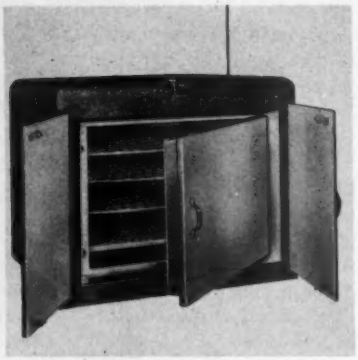
* This figure included with "Wide Mouth Foods".

FISHER SCIENTIFIC NAMES DEVELOPMENT DIRECTOR

To head its expanding facilities Fisher Scientific Company has appointed Dr. Samuel W. Levine as Director of Development.

A researcher in X-ray and emission spectroscopy, the properties of petroleum reservoirs, and hydrocarbon thermodynamics, Dr. Levine was also active in the development of pioneer microwave radar systems in World War II at the Massachusetts Institute of Technology Radiation Laboratory.

New Equipment and Supplies



PORTABLE ELECTRIC OVEN

Grieve-Hendry Company, Inc., 1101 N. Paulina Street, Chicago 22, Illinois, has announced a new low-priced portable electric oven, called the Model HT, for processing at a temperature range of 100° to 800°F.

The oven features extremely uniform temperature throughout. Construction permits the nesting of one oven on top of another. They can be used in groups or banks and can be operated individually or selected ovens in the group can be cut out or heated at different temperatures.

WORKING HEIGHT LIFTER

Lewis-Shepard Products Inc., Watertown, Ohio, has announced the addition of a working height lifter to its "Master" line of materials handling equipment.

As the name implies, the new piece of positioning equipment keeps the work at convenient working height thus eliminating unnecessary lost time and reducing operator fatigue and danger of injury. Lifting, stopping, and lowering of the load are controlled by remote pedal switches which can be conveniently located since they are mounted on a single steel plate at the end of a 15-foot long cord.

The over-all length of the new lifter is only 8½" more than the platform length and the over-all width only 6½" more than the platform width. The pan type platform lowers to the floor so that unit loads on skid platforms or pallets can be readily placed on the lifter by means of a regular lift truck. The pan platform can also be locked at various heights so that the same lift truck can move the entire lifter to a new location with a minimum of effort.

NEW GLASS BATCH MIXER

The T. L. Smith Company, Milwaukee, Wisconsin, has announced a new Smith 40 cu. ft. glass batch mixer equipped with batch hopper (or feed chute) and pneumatic tilting unit.

The mixer is said to be dust-sealed during the entire batch cycle. A specially designed "dust boot" confines the dust within the mixer drum thereby minimizing the dust hazard. The dust boot is placed in a pit for the discharge of mixed batches to the floor below.

MINNEAPOLIS-HONEYWELL ADDS NEW PYROMETERS TO LINE

Minneapolis-Honeywell Regulator Company, Brown Instruments Division, Philadelphia 44, Pa., has announced the addition of five new pyrometer supply items to its line.

These additions include a cast iron, closed-end protecting tube for molten aluminum applications; a two-conductor, 24-gauge copper constantan thermocouple wire; a portable, immersion, removable-tip thermocouple; a 20-gauge JX and KX two-conductor insulated extension wire; and a one-inch, I.P.S. resisteat protecting tube.

FOAMED PHENOLIC RESIN FOR PACKAGING

Bakelite Company, Division of Union Carbon and Carbide Corp., 230 Grove Street, Bloomfield, New Jersey, has developed a foamed phenolic resin for use in the packaging industry. It is designed primarily for packing lightweight fragile items with savings in weight, packing cost, and breakage. Foamed resin is a good thermal insulator and is finding application in the shipment of temperature sensitive material.

Various formulations of phenolic resins can be supplied by Bakelite Company to yield foams having different "core" densities. Foams from phenolic resins are readily prepared by mixing the specially formulated phenolic resins with acidic catalysts. In the Bakelite laboratory and in two customers' plants, foam is produced in blocks having a volume of about 65 cubic feet and, according to the company's statement, a production rate of 4 to 6 such blocks per hour can be obtained with two operators.

CATALOGS RECEIVED

Wheelco Instruments Company, Chicago, Illinois, has announced the distribution of a four-page, two-color bulletin about its new Multipoint Capacilog, a strip chart recorder.

The bulletin explains how up to six permanent records of industrial processes may be obtained on one strip chart. The accuracy of the deflection type measuring circuit, the Wheelco "Electronic Link", and the simple chart printing mechanism used in the Multipoint Capacilog are described. An open view of the instrument illustrates the unique arrangement of the basic recorder assemblies. Complete specifications and a listing of models are included.

The Chas. Taylor Sons Company, Cincinnati, Ohio, has issued Bulletin 315, a 16-page well illustrated bulletin which discusses the properties and applications of Taylor Sillimanite superrefractory ramming mixes and patches.

Comparative test blocks are illustrated and suggested procedures are given. Tables show properties and other statistical material for reference purposes.

Selas Corporation of America, Philadelphia 34, Pa., has published a new bulletin entitled, "Precision Tools for Production."

The bulletin highlights the importance of heat processing machines as automatically controlled precision tools in production lines. Descriptions and illustrations include glass sealing, selective hardening, melting, normalizing, scientific filter production, etc.

Minneapolis-Honeywell Regulator Company, Industrial Division, Philadelphia 44, Pa., is distributing a data sheet devoted to the subject of automatic measurement and control of glass level.

The leaflet discusses instrumentation, operation of the measuring system, and operation of the control system. Included is a schematic diagram of a glass level system, together with other illustrations pointing up the application of the system.

The Hevi Duty Electric Company, Milwaukee 1, Wisconsin, has issued a new combustion tube furnace bulletin, LAB-1236-A, which will replace LAB-1236.

The illustrated bulletin describes the uses, construction, and specifications of Hevi Duty combustion tube furnaces, including many industrial and laboratory applications.

Korb-Pettit Wire Fabrics and Iron Works, Inc., 1505 North Mascher Street, Philadelphia 22, Pa., has announced its Catalog No. 31 featuring its conveyor systems.

The 40-page booklet contains illustrated standard and special types of wire belting weaves with specifications and detailed descriptions. Power formulae and construction details are covered fully, as well as suggestions for prolonging belt life and increasing efficiency.

Battelle Memorial Institute, Columbus, Ohio, has published a booklet whose subject is production engineering.

Commentary on the Institute's work in this particular phase of its research is given, together with laboratory scene from five production research projects carried on at Battelle.

Illustrated above is the Physical Testing Section which with eleven other separate units constitute The Pemco Research and Development Laboratories.

"We are ready to make a test for you, too!"

For all practical purposes, the Pemco Research and Development Laboratories are part and parcel of your own production facilities. For here, in actuality, is a laboratory whose sole purpose is to be of help to you. Staffed with laboratory technicians and ceramic engineers of the highest qualifications, and equipped with the most modern devices of this scientific age, the Pemco laboratories directly serve the user of glass colors as a contribution to the advancement of the entire glass industry. While the Pemco laboratories are the biggest and the most advanced in this field, they are never too big nor too busy to cope with the production problems of even the smallest shop. If *you,* in your own plant, have a production problem which needs solving, submit us a sample of your product. We'll gladly make a test for you, or better still, let us have our Pemco Field Engineer call on you. Write, phone or wire today!

The 1951 Merit Award and the Approved Process Seal of the American Society of Industrial Engineers were presented to Pemco exclusively in its field.

"After All, It's the Finish that Counts"

PEMCO CORPORATION

"Always Begin with a Good Finish"

5601 EASTERN AVE., BALTIMORE 24, MARYLAND

"THE WORLD'S FINEST" PORCELAIN ENAMEL FRITS • GLAZE FRITS • PORCELAIN ENAMEL COLORS • GLAZE STAINS • GLASS COLORS AND RELATED CERAMIC MATERIALS

DROP-TEST INSPECTION

The Eastern Weighing and Inspection Bureau has announced that a representative will call upon shippers of glassware, chinaware, crockery, etc., to see whether the drop-test requirements of the Classification are being properly followed.

It is felt by the Bureau that some check on these products should be made since products which have not been tested in accordance with the classification rule are not entitled to the lowest rate. Also, faithful adherence to the drop tests has, apparently, resulted in a reduction of damage claims to the advantage of all concerned.

DIAMOND GRINDING WHEELS CONFERENCE

Because of the shortage of diamond-crushing bort, the National Production Authority is considering the issuance of an order to restrict end uses of diamond grinding wheels and limit the concentration of diamonds in certain types of wheels. This announcement was made at an informal conference with NPA officials and 15 manufacturers of diamond grinding wheels.

NPA said the proposed order would prohibit the use of diamond grinding wheels in the processing of cement and cement blocks, ceramic tile, mirrors, pencil edging of glass, stone and marble, limestone and slate, and dental diamond points. It would also limit the quantity of diamonds to 72 carats per cubic inch content in any diamond grinding wheels representing 100 per cent concentration.

Most of the manufacturers objected to the issuance of the proposed order, stating that little diamond-crushing bort would be conserved. The proposed restrictions represent only about 20 per cent of end uses of diamond grinding wheels, they said, and would affect small businesses the most.

To conserve diamond crushing bort and insure its use in defense production, the manufacturers offered these alternatives: (1) a government allocation system under which the supply of bort would be regulated upon its arrival in U.S. ports. Consumers would certify to NPA their requirements, and NPA would allot the bort directly to them. This would more equitably distribute the available supply, the manufacturers declared. (2) An intensive conservation program under which consumers would collect dust from grindings, return stubs of diamond wheels, salvage diamonds from sludge, and reclaim diamonds from old wheels. As much as 10 per cent of the carats would be saved, it was estimated.

WESTINGHOUSE SETS UP INFORMATION SERVICE

A Department of Information Services has been formed by Westinghouse Electric Corporation. Heading the new department as Director of Information Services is Dale McFeatters, who has served as Director of Employee Information since joining Westinghouse in 1945. Prior to that time, he was business editor of the Pittsburgh Press for six years. In his new position, he will report directly to Gwilym A. Price, President.

Included in the new section will be all functions of public and employee relations, and related activities.

For Fine Glass ... for Quality **STEMWARE**

SOLVAY

POTASSIUM CARBONATE

Dustless Calcined Potassium Carbonate 99-100% K_2CO_3

Granular Hydrated Potassium Carbonate 83-85% K_2CO_3

Always specify Solvay Potassium Carbonate for Fine Optical Goods
Fluorescent Tubes • Stemware • Laboratory Glassware

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SOLVAY Alkalies Chemicals 70 YEARS OF SERVICE 1881 1951

G. E. DEVICE USED FOR HEAT CONTROL IN GLASS THREAD MANUFACTURE

A temperature control system which automatically maintains a constant white heat for the production of glass "threads" 60 times finer than a human hair has been put into operation by the Owens-Corning Fiberglas Corporation. Devised in cooperation with engineers of the General Electric Company, the system has been installed in the Owens-Corning plant at Santa Clara, California.

In forming the threads, white-hot glass flows from furnaces into narrow channels pierced by hundreds of tiny perforations. As the streams of molten glass pour through the perforations, jets of high-pressure steam blow them into the finer-than-hair fibers. Any marked deviation in temperature would seriously impair the quality of the fibers.

General Electric's Reactrol control plays a vital role in this delicate process by holding processing temperatures at a constant point about 2000° F. In accomplishing this, 18 Reactrol units, 16 saturable reactors to regulate the flow of electric power, an air circuit breaker, and a polyphase watthour meter are included in the G.E. equipment.

BOOK REVIEW

Gas Discharge Lamps
By J. Tunke and P. J. Oranje

The story of the first electrical distribution systems to carry electricity for the production of light and other developments is told in this book. The general discussion in each chapter and the basic lamp characteristics are not limited to the products of any one company, but are of general application and interest.

The sections dealing with sodium lamps, medium and high pressure mercury vapor lamps, and low pressure tubular fluorescent lamps are comprehensive and informative.

Published by N. V. Philips' Gloeilampenfabrieken, Eindhoven, Holland, 270 pages.

• The Wheelco Instruments Company has announced the opening of a new District Agency for the state of West Virginia. The agency is the Engineering Products Company located at Charleston.

MELTING *and* FINING

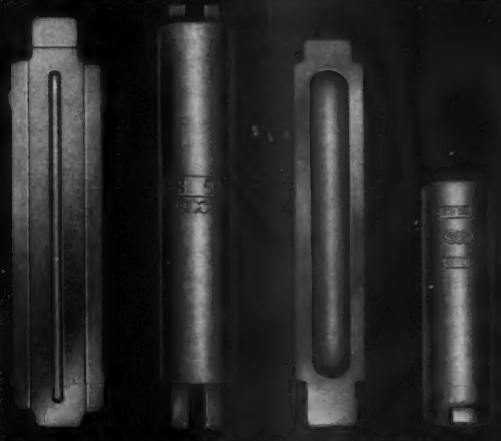
BORAX... a small addition of B_2O_3 to the glass batch, if properly substituted for a part of one or more of the major constituents, will improve the melting temperature and fining rate which should effect economies in fuel and refractory life.

Our representatives are prepared to discuss all the special advantages of B_2O_3 in glass.

PACIFIC COAST BORAX CO.
Division of Borax Consolidated, Limited
New York • Chicago • Cleveland • Los Angeles

GUNITE

RING STICKS



Ring Sticks are carefully cast to your specifications from your own patterns. Readily machinable.

BAR STOCK

Round bars in standard 14 inch lengths. 1/2 inch diameter to 5 inch diameter by 1/4 inch increments. ALL GUNITE castings are made of Gunite Metal suitably alloyed to provide the ideal glass house material. Gunite Metal is easily machined and readily polished to a mirror finish. Gunite Metal has maximum resistance to heat checking under the severe conditions imposed by glass making operations. You'll get superior service from GUNITE.

PLUNGERS

Standard plungers in all sizes from MG1 to MG10. Easily machined and polished to a mirror finish.

GUNITE FOUNDRIES CORPORATION

ESTABLISHED IN 1854

ROCKFORD GUNITE ILLINOIS

G-E ANNOUNCES NEW TRANSPARENT SCREEN FOR TV TUBES

Clearer television pictures, with greater contrast between light and dark areas, are foreseen with a new transparent screen for picture tubes which has been developed by scientists of the General Electric Research Laboratory.

The tubes, which are still in the developmental stage requiring further work, are coated inside with a powder which appears white or gray and which is the darkest that any areas on the screen can be. When looking at one with a transparent screen, however, the viewer sees through it into the dark recesses of the tube.

The best of the new transparent screens at present show a yellow-orange picture, the scientists said. Although this is not unpleasant, it is believed that further research will make possible a true black and white picture. According to the scientists, on the present powder screen, powder particles near a bright spot pick up some of its light and reflect it to the eye, thus causing a halo around the spot. There is no such powder on the transparent screen to pick up light and cause such a halo, they said.

RADIATION ABSORBING GLASSES AVAILABLE

Bausch & Lomb Optical Company has been granted a non-exclusive license to produce high-energy X-ray and gamma ray absorbing glasses covered by U.S. Patent No. 2,518,194 granted to Joseph J. Rothermel, Kuan-Han Sun, and Alexander Silverman on August 8, 1950. Dr. Rothermel, Powder House Road, R.D. 3, Corning, New York, has been authorized to negotiate contracts for the patentees.

The slow neutron absorbing glass recently developed by Laben Melnick, Hurd W. Safford, Kuan-Han Sun, and Alexander Silverman is also available for licensing. Mr. Melnick, 5623 Callowhill Street, Pittsburgh 6, Pa., has been authorized to represent this group.

VITRO ANNOUNCES RESEARCH SPONSORSHIP

The Vitro Manufacturing Company has announced the sponsorship of a number of cooperative research investigations in the field of physical and chemical technology relative to the development and manufacture of colors for the ceramic industries.

The institutions selected for these projects are Battelle Memorial Institute, Columbus, Ohio, and the Institute of Research at Lehigh University of Bethlehem, Pa. Both institutions have begun their investigations on certain specific projects outlined by the Vitro organization.

ANNUAL MEETING OF A.C.S. PITTSBURGH SECTION

The Pittsburgh Section of the American Ceramic Society will open its 1951-52 season, under the chairmanship of Donald E. Walsh of the Consolidated Feldspar Company, with its annual stag golf outing and banquet on September 7, 1951.

In addition to golfing, tennis and swimming facilities will be available. A trip through the Elliott Company in nearby Jeannette, Pa., has also been arranged. The arrangements for this meeting have been made by a committee headed by Gerald A. Terrell of McKee Glass Company.

Harshaw's newest

WHITE GLASS ENAMEL

- Increased Coverage
- Finer Decorative Detail
- Anti-Slugging

HARSHAW

• Harshaw's white glass enamel, in impartial production runs, has decorated 8% to 35% more bottles per pound of glass enamel than other brands.

Also, sharper decorative lines and smaller letters are made possible with this new white glass enamel for decoration of glassware by the silk screen process.

Another important advantage is its anti-slugging properties. When production is resumed after a slow down or stoppage there is little or no smearing of your product. Harshaw's new white does not have the tendency to "seep thru" the silk screen.

Contact the nearest Harshaw branch office for additional information or quotation.

THE HARSHAW CHEMICAL CO.

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CLEVELAND • CHICAGO • CINCINNATI • DETROIT • HOUSTON • LOS ANGELES • PHILADELPHIA • PITTSBURGH • NEW YORK

TEMPERATURE INDICATING PAINTS . . .
(*Continued from page* 412)

enable the working temperature to be controlled within very definite limits. This same usage, i.e., the use of two different spots, can be adapted to mold preheating. Molds which are to be preheated before placing on the forming machine can be painted on the rough side with two different and suitable temperature range paints and the color change used as an indicator of the proper reheat temperature.

For experimental work they have good possibilities since intricate surfaces of moving parts on which elaborate measuring equipment would normally be required can be coated with one or more of these colors and isotherms plotted from the resulting color changes. In the glass container field a modification of this use would be in a study of the outside surface temperature of the forming molds while the forming machine is in operation.

Such paints, if used on the outside surfaces of the tank block or the furnace crown, would give an indication of the outside surface temperatures, the temperature distribution in a single block or over the entire furnace and would also indicate the rate of wear at the fluxline or other vulnerable points in the furnace.

Other simple and inexpensive "around-the-plant" uses are: the safeguarding of bearings, motors, circuit breakers, etc., from overheating; the detection of faulty insulation of high pressure steam pipes or other high temperature insulated points; and for the detection of burners which have "struck back." Other uses for such temperature indicating paints in the glass industry will suggest themselves.

BOOK REVIEWS

New Russian Books on Glass

I. I. Kitaigorodskii. "Glass and Glass Making." Published by Promstroiizdat, Moscow 1950. 416 p., 96 references. Price 20 rub. 40 kop. The book discusses the author's research work on physical chemistry and technology of glass; new glass types; the shortcomings of the present glass tanks; the kinetics of glass formation and its importance for the future development of glass manufacture; and application of glass in industry and in building trades.

S. I. Korolev. "My Experience in the Rationalization of Glass Manufacture." Published by Promstroiizdat, Moscow 1950. 108 p. Price 5 rub. 60 kop.

V. S. Podyelskii and N. P. Krasnikov. "The Method of Thin-Layer Introduction of Charge Into Glass Tanks." Published by Promstroiizdat, Moscow 1950, 47 p. Free of charge.

"Collection of Scientic Papers on Glass." Published by Promstroiizdat, Moscow 1950. 259 p. Price 17 rub. 75 kop. Book presented to Professor I. I. Kitaigorodskii on his 60th anniversary. It contains papers on the physical chemistry of silicates, on the technology of glass-making, and on the refractories used in glass industry.

• Fish-Schurman Corporation has announced removal of their new operations to 70 Portman Road, New Rochelle, New York.

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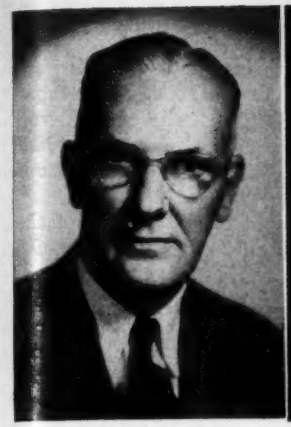

J. P. McCarthy

R. L. Sears

LYNCH CORPORATION REORGANIZES OHIO DIVISIONS

In announcing the reorganization of the Ohio Divisions of the Lynch Corporation, Frank K. Zimmerman, President, named Joseph P. McCarthy as General Manager and R. L. Sears as Sales Manager.

Mr. McCarthy has been associated with Lynch Corporation since 1938 as a manufacturing executive. Mr. Sears became Director of Sales for the Par Compressor Division in 1944. Long associated with the refrigeration industry, Mr. Sears was recently elected Vice President of the Refrigeration Equipment Manufacturers Association.

The Ohio Divisions of Lynch are comprised of two manufacturing plants: the Packaging Machinery Division and the Par Compressor Division.

COLORADO FUEL & IRON APPOINTMENT

Howard J. Davis has been appointed Assistant to Colorado Fuel & Iron Corporation's Executive Vice President, A. F. Franz, according to an announcement from the company.

Mr. Davis joined the firm in 1940 to establish a welded wire fabric division at the Pueblo mill. In June 1947 he was appointed Manager of Product Research and Development, later named Manager of Sales for Wire Products. In April 1949 he was made Assistant General Manager of Commercial Sales for the Colorado Division. He was made Assistant to the Vice President of Sales.

LEEDS & NORTHRUP NAMES EXECUTIVE VICE PRESIDENT

The election of I. Melville Stein to the newly created post of Executive Vice President has been announced by the directors of Leeds & Northrup Company. Mr. Stein has been a vice president and is Director of Research.

Joining Leeds & Northrup in 1919 as a division manager in the sales department, Mr. Stein became Research Director in 1928, and Vice President in Charge of Research in 1944. During World War II he served as a member of Division 17 and Chief of Section 17.2 of the National Defense Research Committee for which he received a President's Certificate of Merit.

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Chlorides as NaCl	0.10 to 0.16%	0.04 to 0.08%
Iron as Fe	30 to 35 Ppm	2 to 8 Ppm
Arsenic as As_2O_3	20 to 40 Ppm	3 to 8 Ppm
Sulphates as Na_2SO_4	0.3 to 0.4%	nil
Carbonates as Na_2CO_3	nil	nil

•

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EAST ASIATIC GLASS . . .

(*Continued from page* 404)

were suspended ending in sumptuous pendants. One such pendant from the Gold Crown Tomb is an elongated bulbous shape of dark blue glass enclosed in a woven network of delicate gold chains, and gold-capped above and below. Surely this ornament, so sumptuously treated, was a particularly valued "gem".

The presence of glass and the nature of its use in these rich burial chambers of the Silla kings is witness of the esteem in which this precious, jewel-like substance was held. The foreign bowls and cups must have been cherished not only for their own delicate charm but for the wonder of their long trek across the Asiatic expanse, or because they came from the brilliant Chinese court. Early local achievements in this medium would also have been treasured. The thousands of beads found in Korean tombs (twenty-five thousand or more from the Gold Crown Tomb alone) are sufficient proof of local glass production. Furthermore, their variety suggests that they are not entirely imitations of foreign styles. The peculiarly vivid blues and greens, the crystal-clear quality of some uncolored glass, and the rich amber-yellow and brown explain why glass was esteemed here, as elsewhere in East Asia, as a precious substance.

I doubt if the history of glass in post-Silla times can be clearly outlined. In 935 A.D. the Koryo people of northern Korea emerged again and conquered Silla. In 1392 they were, in turn, replaced by the Yi Dynasty, which lasted until the beginning of Japanese domination in 1910. Certainly glass was produced to some extent during all of these centuries. There are various small ornaments which probably date from the Koryo period. Also, certain bead forms continued in use after the Three Kingdoms and Silla periods. Cap buttons, beads for hat embellishment, game counters, and other forms exist from the more recent centuries, but they are of little significance as compared with the glass interred in the ancient royal tombs of what may be termed the Golden Age of Korean art.

FOOTNOTES

[1]A few items of glass (ear ornaments) have been found also in ancient tombs of Manchuria, but do not warrant separate discussion.

[2]cf. The Glass Industry, July 1951, p. 347.

[3]There is in The Toledo Museum of Art a crude human figure of glass said to have been exhumed at Lo-lang in 1916 which would seem to support the theory of local manufacture as it would scarcely have been transported from distant China unless of deeply religious importance, a possibility which is being investigated.

[4]Fortunately, Kyongju lies within the Pusan "beachhead" of the United Nations forces, and therefore was saved from the devastation experienced by other localities of historic and artistic importance. Glass in the Museum at Seoul, unless removed before June 1950, has presumably not fared so well.

[5]cf. Kim, Chewon: Two Old Silla Tombs—Ho-u Tomb and Silver Bell Tomb. Pls. XLV and XLVI, and pp. 21-22.

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The Toledo Museum of Art. Exhibition of East Asiatic Glass, Oct. 1948.

(To Be Continued)

SYLVANIA MEN TO HAVE PAPERS READ AT INTERNATIONAL ILLUMINATION SESSIONS

Dr. E. F. Lowry, Manager of the Lighting Division Engineering Laboratories, and R. G. Slauer, Applications Engineer, both of Sylvania Electric Products, Inc., were among the five American lighting experts whose technical papers were selected for presentation in Stockholm, Sweden, during the annual sessions of the International Commission on Illumination.

In his paper, "The Evolution of the Fluorescent Lamp", Dr. Lowry reported on some of the important engineering achievements accomplished in the field of fluorescent lighting since it was introduced in 1938. He explained that each of the new types and sizes of lamps which have been placed on the market are designed to fit a particular need. The availability of seven fluorescent lamp colors and the recent achievement of 7500 hour life for fluorescent lamps were also discussed.

Mr. Slauer, in his paper, "Space Concepts of Lighting", said that the fluorescent lamp, because of its linear characteristic, coolness, and low brightness, has given architects a flexible tool for space control.

T. W BASSETT OF DOMINION GLASS HONORED BY TOWN

Thomas W. Bassett of Montreal, Vice-President and General Manager of the Dominion Glass Company, was made an honorary citizen of the town of Wallaceburg recently at a special gathering held in his honor at the Hotel Mirwin.

On behalf of the town Mayor Wilfred J. Picard presented Mr. Bassett with scrolls indicating the high honor conferred upon him by Wallaceburg's citizens as a whole.

The mayor spoke of Mr. Bassett's unselfish service to the community as a whole and of his unfailing interest in the development of the young men and placing them in positions of trust.

BATTELLE STARTS ERECTION OF NEW LABORATORY

Clyde Williams, Director of Battelle Memorial Institute, has announced the beginning of construction on a new million-dollar laboratory which is being erected due to increased demands for research services in behalf of the nation's defense effort. The construction has been approved by the National Production Authority as a result of endorsement by military and other governmental agencies.

The new construction will be Battelle's fifth in the past decade. A three-story structure with two bays for pilot plant operations, the new building will provide approximately 80,000 square feet of work area and will house 115 unit laboratories. It is expected that the building will allow a 15 to 20 per cent increase in Battelle research services.

O. HOMMEL ADDS TO RESEARCH STAFF

The O. Hommel Company has announced the appointment of Joseph W. Toth to its research department. Mr. Toth received his chemical education at Gannon College in Erie, Pa. Following graduation, he joined the Continental Rubber Company. Mr. Toth will assume the duties of an analytical chemist in the company's plant laboratories.

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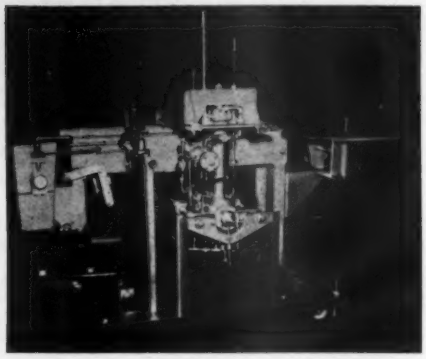

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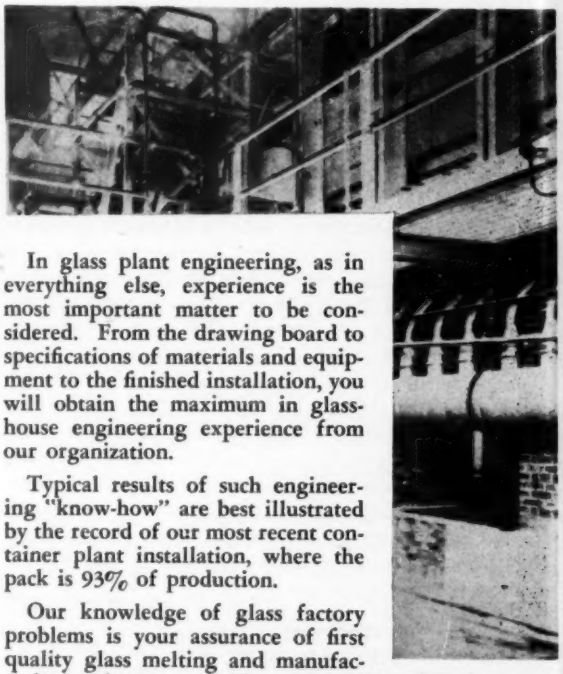
INVENTIONS AND INVENTORS . . .

(*Continued from page* 415)

One use of this method is to increase the adhesion between laminated sheet glass and the resin. The patent contains 12 examples setting forth the use of this method, the first being as follows: A small glass plate was treated with a dilute solution of phenylsilicon trichloride in benzene and then rinsed with pure benzene. A piece of glass fiber tape was then cemented to the treated glass surface with polymethylmethacrylate. The shearing stress required to tear the tape loose from the plate was measured and found to be 2.6 kg. per sq. cm. A similar sample after immersion for thirty minutes in boiling water required 3 kg. per sq. cm. In comparison, another plate on which the glass tape was cemented directly to the glass without any preliminary treatment thereof required a shearing stress of .7 kg. per sq. cm., and with a similar sample after thirty minutes immersion in boiling water the glass tape spontaneously separated from the glass plate.

The patent contains two claims and six references were cited: 2,215,048, McGregor et al., Sept. 17, 1940; 2,258,218, Rochow, Oct. 7, 1941; 2,258,222, Rochow, Oct. 7, 1941; 2,286,767, Shutt, June 16, 1942; 2,306,222, Patnode, Dec. 22, 1942; and 2,390,370, Hyde, Dec. 4, 1945.

• Samuel G. Hibben, Director of Applied Lighting of Westinghouse Electric Corporation, has been elected President of the Illuminating Engineering Society to serve a one-year term starting October 1.



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RESEARCH DIGEST . . .

(*Continued from page* 417)

this investigation should be given full consideration. This method can be carried out quickly and cheaply on comparatively small specimens. It can also be adapted to show either the corrosion due mainly to solution or due to solution and erosive action together, depending on whether the test specimens are held stationary or are caused to move slowly through the molten glass during the test. In the present series of experiments, the tests carried out with the specimens stationary indicate that the amounts of corrosion of the individual specimens are substantially in the same proportion as the corrosion obtained where the specimens are rotated, though the actual corrosion is considerably less. This is in accordance with expectation and if it should prove to be generally true, there would be no reason for carrying out stationary tests, since to do so would merely involve a longer period of testing to give equally reliable measurements of the corrosion, without altering the placing of the various specimens in order of corrosion-resistance.

The adoption of this or any other test must, of course, depend on whether the performance of blocks in full-scale trials corresponds with the performance predicted from test trials made on sample blocks or on specimens cut from sample blocks.

• American Potash & Chemical Corporation has reported net earnings for the six-months' period ended June 30, 1951, of $1,173,918, compared with $1,035,907 for the corresponding period in 1950.

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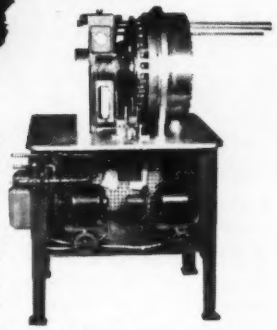

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